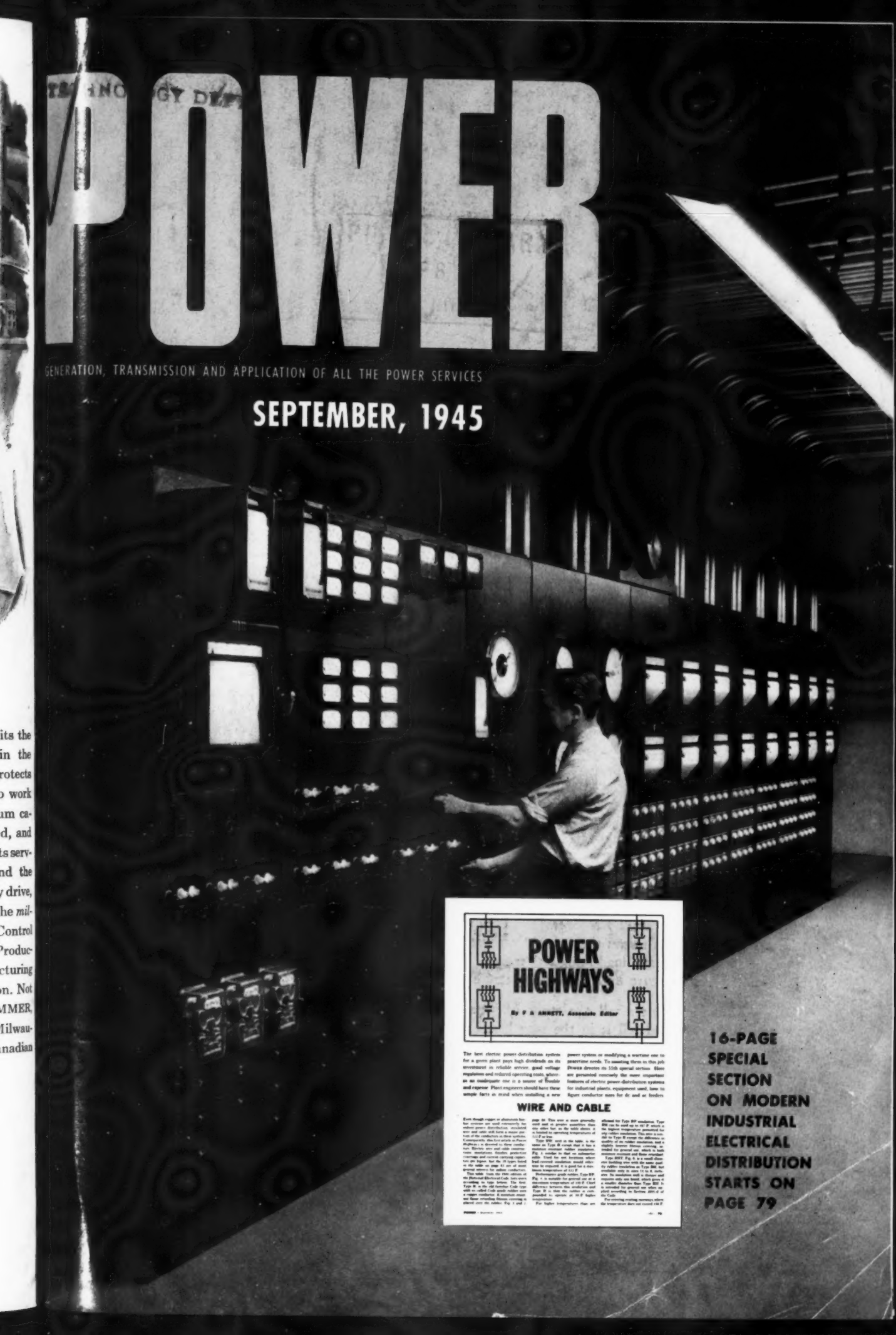
POWER

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

SEPTEMBER, 1945



POWER HIGHWAYS

By F. A. ARNETT, Associate Editor

The best electric power-distribution system for a given plant pays high dividends on its investment in reliable service, good voltage regulation and reduced operating costs, whereas an inadequate one is a source of trouble and expense. Plant engineers should have these ample facts in mind when installing a new power system or modifying a wartime one to peacetime needs. To assisting them in this job Power devotes its 16th special section. Here are presented concisely the more important features of electric power-distribution systems for industrial plants, equipment used, how to figure conductor sizes for dc and ac feeders

WIRE AND CABLE

Even though copper or aluminum bus bar systems are used extensively for outdoor power distribution, insulated wire and cable still form a major portion of the conductors in these systems. Consequently, the first article in Power Highways is devoted to these conductors. Electric wire and cable construction, insulations, finishes, protective coverings and current-carrying capacities are discussed. Tables 1 to 6 inclusive on page 81 are of most general interest for indoor installations.

This table lists the 1944 edition of the National Electrical Code tests more according to type letters. The first Type R is the old familiar Code type with so-called Code grade rubber over a copper conductor. A minimum enamel finish overall is allowed over the rubber. Fig. 1 and 2 page 81. This wire is most generally used and in greater quantities than any other but as the table shows it is limited to operating temperatures of 140 F or less.

Type RW used in the table is the same as Type R except that it has a moisture resistant rubber insulation. Fig. 1 similar to that on submarine cable. Used for wet locations where load current conditions would otherwise be required it is good for a maximum temperature of 140 F.

Performance grade rubber. Type RP Fig. 1 is suitable for general use at a maximum temperature of 140 F. Chief difference between this insulation and Type R is that the rubber is compounded to operate at 50 F higher temperature.

For higher temperatures than are allowed on Type RP insulation, Type RW can be used up to 167 F which is the highest temperature permitted for any rubber insulation. This wire is similar to Type R except the difference in quality of its rubber insulation and a slightly heavier fibrous covering, as braided for general use, which is both moisture resistant and flame retardant.

Type RHT Fig. 4, is a small diameter building wire with the same quality rubber insulation as Type RW, but available only in sizes 14 to 6. Intended for installation until a thinner and smaller diameter wire which gives a smaller diameter conduit. Type RH is a intended for general use above 4 and is rated according to Section 4004 of the Code

For entering existing raceways where the temperature does not exceed 140 F

16-PAGE SPECIAL SECTION ON MODERN INDUSTRIAL ELECTRICAL DISTRIBUTION STARTS ON PAGE 79

Switchboard in Control Room of Aluminum Co. of Canada's Shipshaw Powerhouse. Note how signal lights and Micromax Recorders are centralized in operator's triangle of vision, with all switches for the Station's hydro-generators at the sides.

SHIPSHAW OPERATOR

Watches Generators via Micromax Recorders

The instruments in Shipshaw Powerhouse's Operating Room are noteworthy for the quick, compact way in which they enable the generation operator to watch the Station's three interrelated conditions of frequency, load and generator temperature.

The Round-Chart Micromax Recorder, just below the clock at the left, shows the frequency.

Beside the Round-Chart Frequency Recorder is a Micromax Strip-Chart Load Recorder. This instrument totalizes the megawatt output of Shipshaw's twelve units.

Below the Frequency and Load Recorders are two Micromax six-point Generator Temperature Recorders; only the top halves are visible in the photograph. Each shows the stator temperature in 6 generators, and warns if the ultimate load-limit is reached, regardless of power factor, ambient temperature or any other contributing factor.

Thus the four Recorders tell the story of what the twelve turbo-generators are doing, and tell it in the way best calculated to help the operator perform his twin duties of carrying the station load and protecting the machines.

Jrl Ad N-161 (7)

Any or all of these L&N Publications will be sent on request, but if you have a problem to which an L&N Recorder or Controller may be applied, we suggest you call in an L&N engineer for specific recommendation.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

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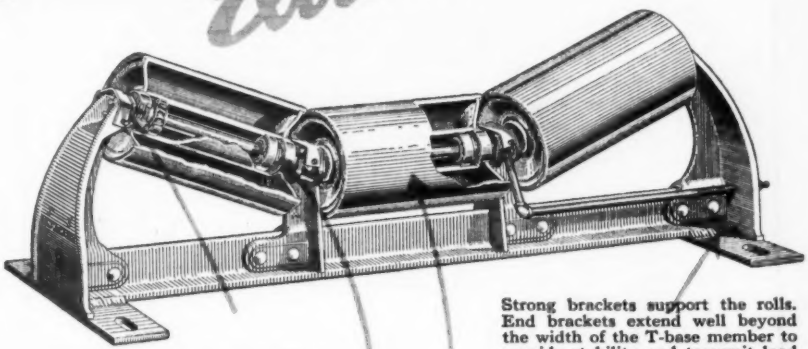
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer") September, 1945, Vol. 89, No. 9. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publications office, 99-129 North Broadway, Albany 1, N. Y. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Please indicate position and company connection on all subscription orders. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year. $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

IT'S THE ENGINEERING OF EACH PART THAT GIVES YOU THAT

"Extra" in Service



Interlocking nuts and yokes prevent brackets from spreading — the hexagonal end-nuts interlock with bracket yokes so that roll shafts actually tie all brackets together.

Strong brackets support the rolls. End brackets extend well beyond the width of the T-base member to provide stability and transmit load directly to rigid steel feet. Center brackets straddle the full width of the horizontal self-cleaning steel Tee-Bar.

POSITIVE GREASE SEAL keeps grease in and dirt out—conserves lubrication — prolongs bearing life. No springs, no loose parts, no sliding metal-to-metal contact.

Rolls are accurately aligned in a sturdy, streamlined frame assembled in jigs to assure correct bracket spacing and roll interchangeability.

● Top performance in belt conveyors depends, in great measure, on the structure on which the load moves. LINK-BELT Roller Bearing Belt Conveyor Idlers are the outgrowth of almost 50 years of constant development. Engineering that progressed to keep ahead of growing service needs has achieved outstanding design in today's LINK-BELT IDLERS.

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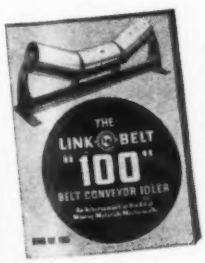

Book No. 1915 gives full particulars

This 16-page book is packed with detailed information on LINK-BELT Belt Conveyor Idlers and the various types available in the "100" series. Drawings are shown with tables giving list prices, dimensions in inches, and weights in pounds. Write today for this book.

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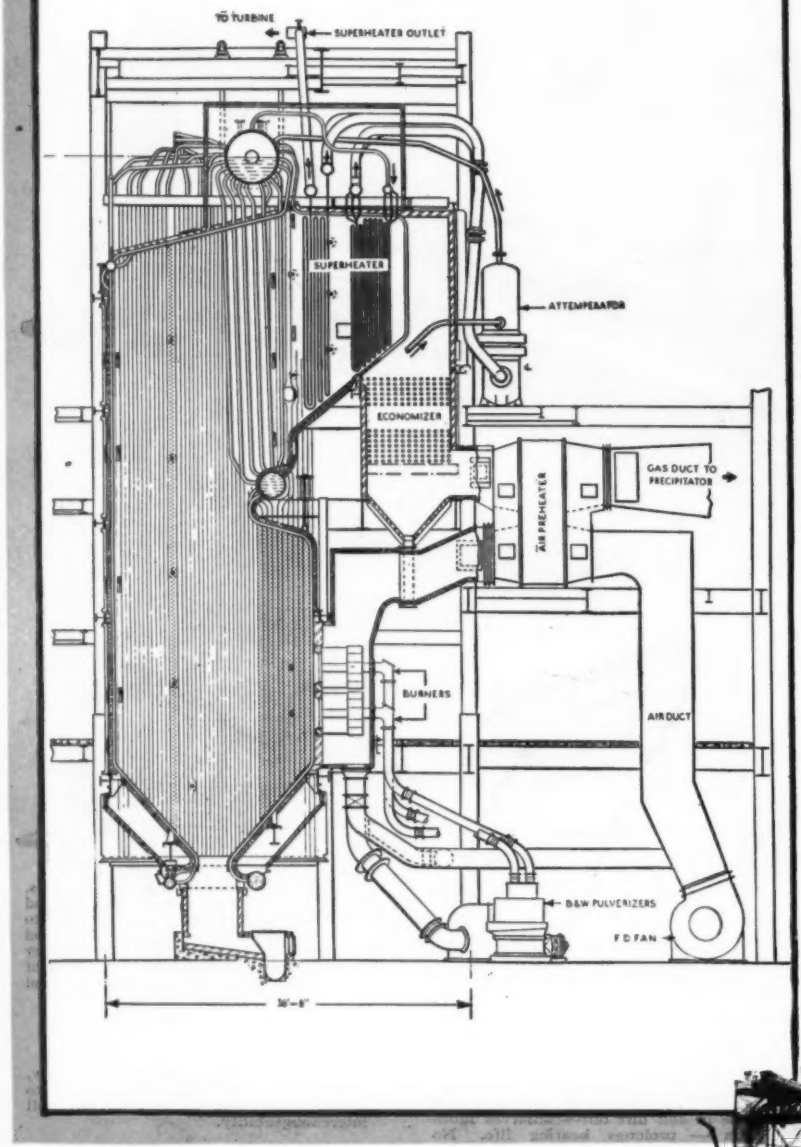
REPORT FROM RIVERSIDE: "unusually

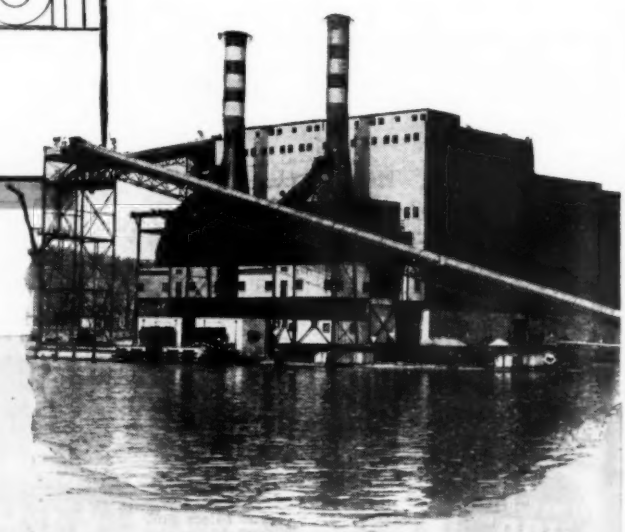


Arrangement of B&W Radiant Type Boilers No. 1 and 2 at Riverside Station and No. 3 at Westport Station of Consolidated Gas Electric Light and Power Company of Baltimore. Rated capacity of each boiler: 550,000 lb per hr at 900 psi and 915 F at superheater outlet. Units are equipped with B&W superheaters, attemperators, economizers, and burners. Three B&W Type E Pulverizers supply fuel for each boiler.

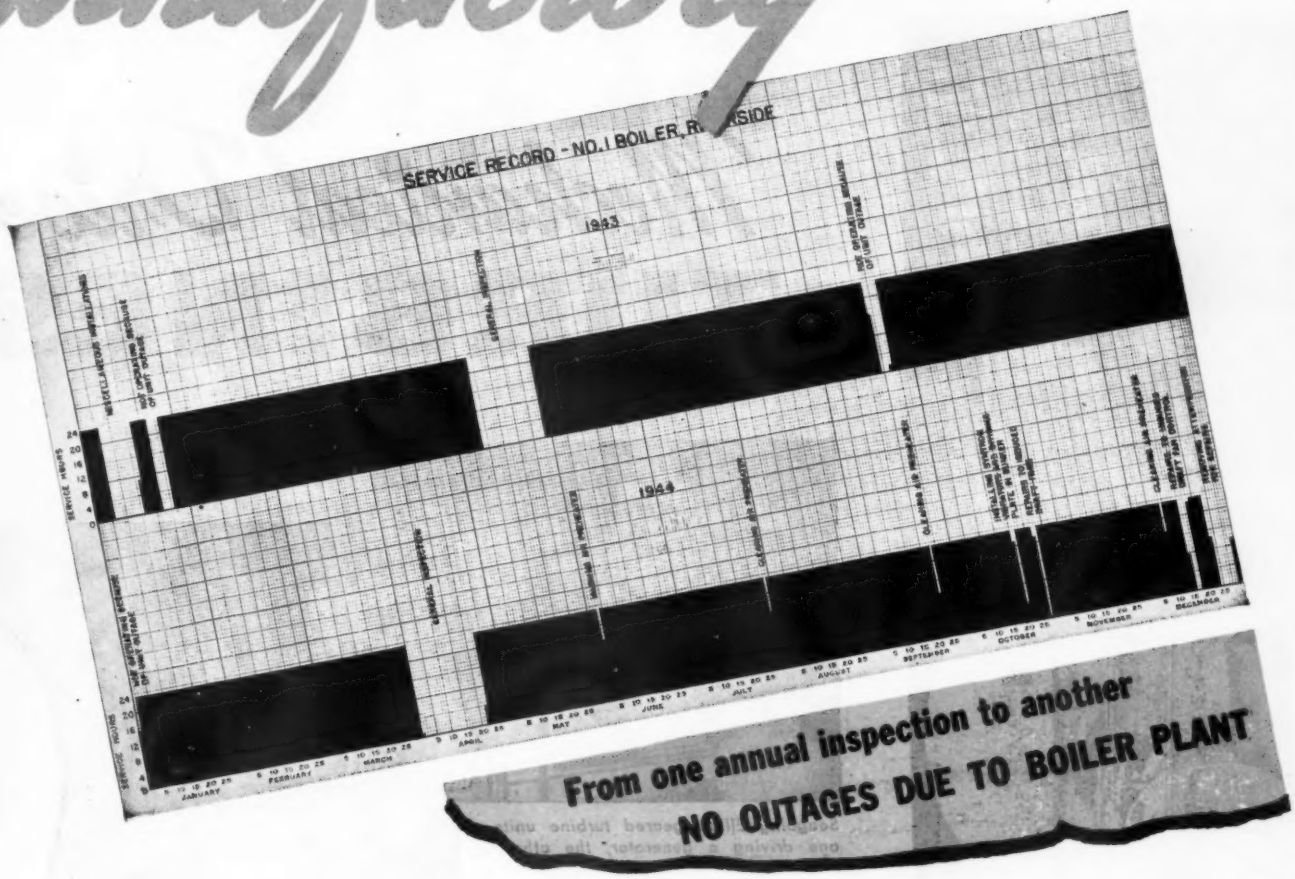
A large factor in meeting increased power demands of the war-busy area of 2,300 square miles served by Consolidated Gas Electric Light and Power Company of Baltimore, is its new Riverside Station. Here, two 550,000 lb per hr B&W Radiant Type Boilers serve two 60,000-kw turbine-generators.

Service records of these boilers to date show a high degree of availability—*in one period between annual inspections, the boiler plant was not responsible for a single outage.* And, the design of these boilers resulted in ". . . slag-free operation of these units which is the more remarkable in view of the wide variety of coal which the war has made necessary and which includes coal containing ash with an initial deformation temperature as low as 1900 F and as high as 2800 F".

Such service records stem from equipment well matched to its job from the start. Riverside's first B&W boiler went into operation in December 1942; the second in April 1944. Both met or exceeded rated capacities and within two weeks following initial operations were, in the



satisfactory"



From one annual inspection to another
NO OUTAGES DUE TO BOILER PLANT

words of the Company's engineers, "just units on the line". Performance of the boilers, in spite of handicaps imposed by war conditions, has fully met expectations. There has been no difficulty in obtaining rated output over prolonged periods. In fact, "operating experience with these steam-generating units is unusually satisfactory," say company officials.

Experience at Riverside is being duplicated by a similar B&W unit at the Westport Station of this Company. Results with these units are not exceptional, but are being repeated by B&W boilers in public utility stations all over the country—reflecting the high standard of performance that has been built into B&W steam-generating equipment for over 60 years.

Thinking and planning for tomorrow *today* is a job that B&W engineers are ready to tackle—in partnership with your engineers—at any time.

G-310T

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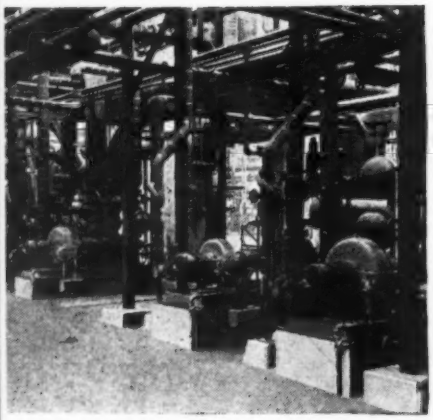
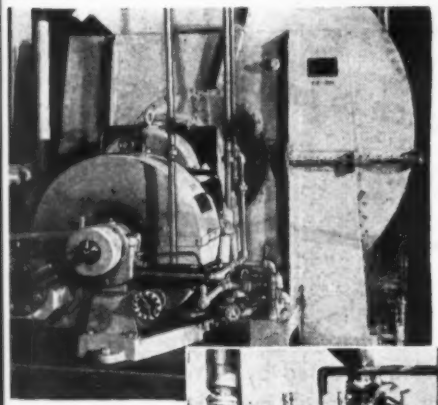
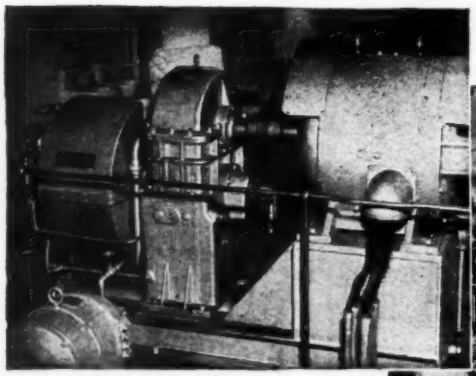
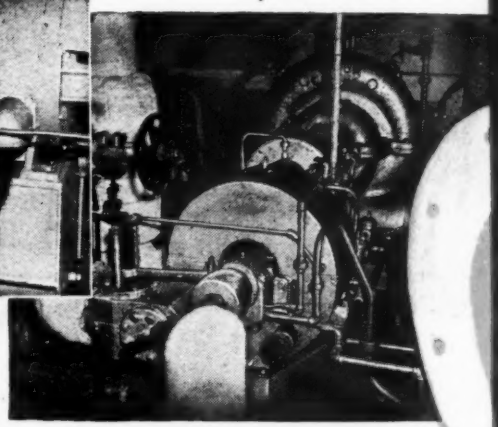


Typical line of Elliott turbines driving pumps in an oil refinery.

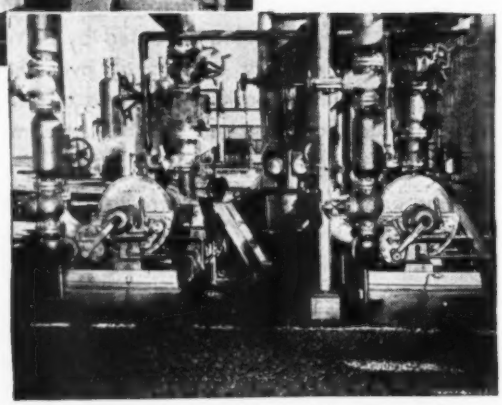
Elliott turbine with built-in gear driving a forced-draft fan in an important war materials plant.



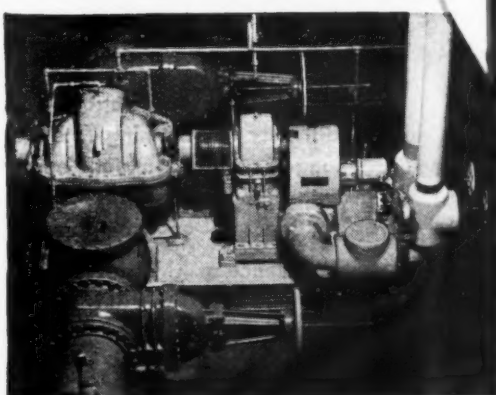




Seagoing Elliott geared turbine units—one driving a generator, the other a centrifugal ballast pump.



Another out-of-doors installation, two of many Elliott turbines driving pumps in a large gasoline cycling plant.



Elliott turbine with built-in gear driving circulating water pump in a recently built steel mill power plant.

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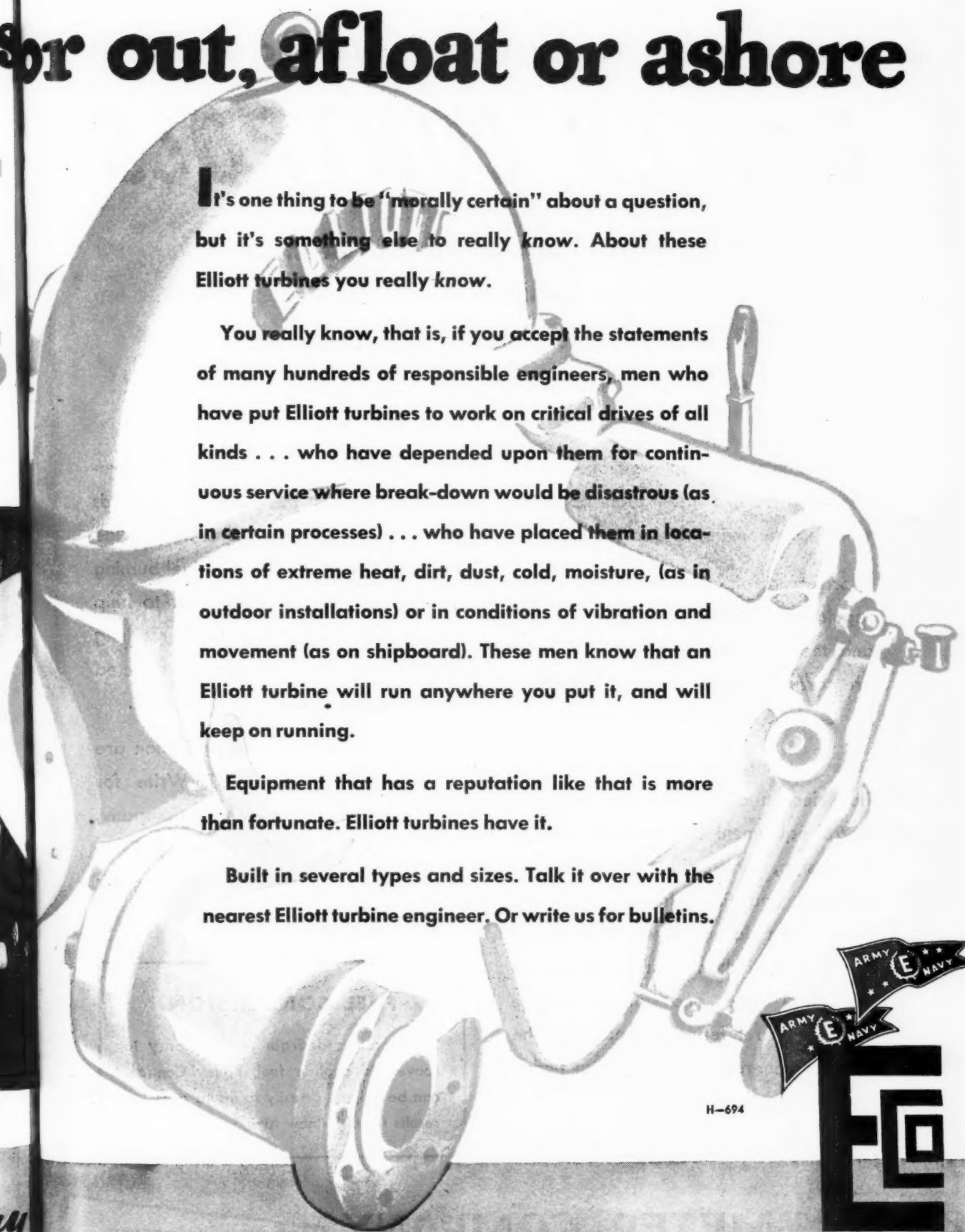

It's one thing to be "morally certain" about a question, but it's something else to really *know*. About these Elliott turbines you really *know*.

You really know, that is, if you accept the statements of many hundreds of responsible engineers, men who have put Elliott turbines to work on critical drives of all kinds . . . who have depended upon them for continuous service where break-down would be disastrous (as in certain processes) . . . who have placed them in locations of extreme heat, dirt, dust, cold, moisture, (as in outdoor installations) or in conditions of vibration and movement (as on shipboard). These men know that an Elliott turbine will run anywhere you put it, and will keep on running.

Equipment that has a reputation like that is more than fortunate. Elliott turbines have it.

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1. **Fuel Conservation without decrease in output.**
2. **Lower Cost Steam.**
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Bailey Controls for boilers make the important factors of steam plant operation work together to insure ideal performance.

In order that all of these factors may be regulated in harmony with each other and the load demand, Bailey Controls are carefully engineered to the requirements of the units which they serve.

Bailey engineering service starts with the selection of suitable metering and control equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Bailey field engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey engineer in your community has extensive experience at his command, which includes tests on thousands of boiler installations, covering a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you secure the many benefits resulting from intelligent use of correctly selected and properly applied boiler control.

Bailey Controls for boiler operation are described in Bulletin 15-C. Write for your copy to Bailey Meter Company, 1036 Ivanhoe Road, Cleveland 10, Ohio —in Canada to Bailey Meter Company Limited, Montreal.

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If it becomes desirable or necessary to convert to another fuel, Bailey Controls can be adjusted easily to insure optimum results from the new fuel.

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Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

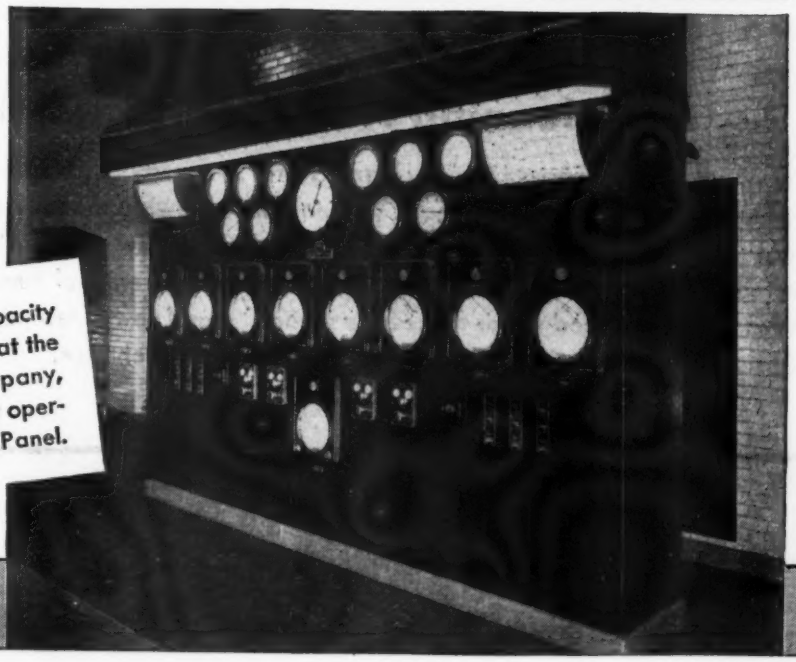
APPLICATION to STOKER FIRED BOILERS

UNDERFEED

This Bailey Control Panel insures optimum performance from three underfeed stokers on two 25,000 and one 40,000 lb. per hour capacity boilers at Parker Appliance Company, Cleveland, Ohio.

SPREADER

Bailey Controls help operators at Graham-Paige Motors Corporation, Detroit, Michigan, to maintain tests standards in everyday operation of this 60,000 lb. per hour boiler fired by a spreader type stoker.



CHAIN GRATE

Two 40,000 lb. per hour capacity chain grate stoker fired boilers at the United States Tobacco Company, Chicago, Illinois, are efficiently operated by this Bailey Control Panel.

Only DIAMOND

Following years of work with manually operated soot blowers using compressed air as the cleaning medium, Diamond installed the first automatically operated air blowers in 1932. Since that time the continuous research, development and application engineering that has been carried on by Diamond has resulted in a "know how" that is unapproached in this field. Experience has proved that some of the problems encountered — both engineering and economic—are different than when steam is the cleaning medium.

Blower Heads Particularly Suited To Air

Experience early proved that certain heads long very successfully used for steam cleaning did not give equally satisfactory results with air as the cleaning medium. This caused the design and development of heads expressly suited to air blowing.

Diamond Developed "Air-Puff" Principle

Sixteen years ago, Diamond introduced automatic sequential "Air-Puff" soot blowing. The compressed air is discharged from the element nozzles in a series of short puffs with substantial pauses between. During each puff the element is automatically rotated to a new position. Spreading the cleaning cycle over a much longer period of time permits the use of a much smaller compressor. The "puff" principle and the long time cleaning period reduce the stack discharge to the point where it is not sufficiently noticeable to prevent daylight blowing in residential areas.

Air Cleaning Has Important Advantages

Labor saving and correct boiler cleaning are common to all Diamond automatic sequential soot blower operation. Cleaning with air instead of steam has additional important advantages: (1) feed water makeup is saved; (2) no piping insulation is required; (3) more energy is saved from the coal pile; (4) dryer blowing medium for surfaces operating near the dew point; (5) more effective medium for slag removal because of its greater density and lower temperature; (6) reduced blower maintenance.

DIAMOND POWER

HAS THIS BACKGROUND OF Experience IN AUTOMATIC SOOT BLOWING WITH Air

Power Boilers having DIAMOND Automatic Soot Blowing with AIR

* CENTRAL STATION	DATE BOILER IN SERVICE	STEAM CAPACITY OF BOILER	TYPES OF AIR BLOWING HEADS USED	METHOD OF OPERATION	METHOD OF CONTROL
A	Sept. 18, 1940	900,000 lb/hr	5	Air and Electric	Air and Electric
A	May 5, 1941	900,000 lb/hr	5	Air and Electric	Air and Electric
B	June 18, 1942	550,000 lb/hr	3	Air and Electric	Air and Electric
B	Sept. 29, 1942	900,000 lb/hr	2	Air and Electric	Air and Electric

Names and additional information furnished on request

SPECIALTY CORP. Detroit 31, Mich.

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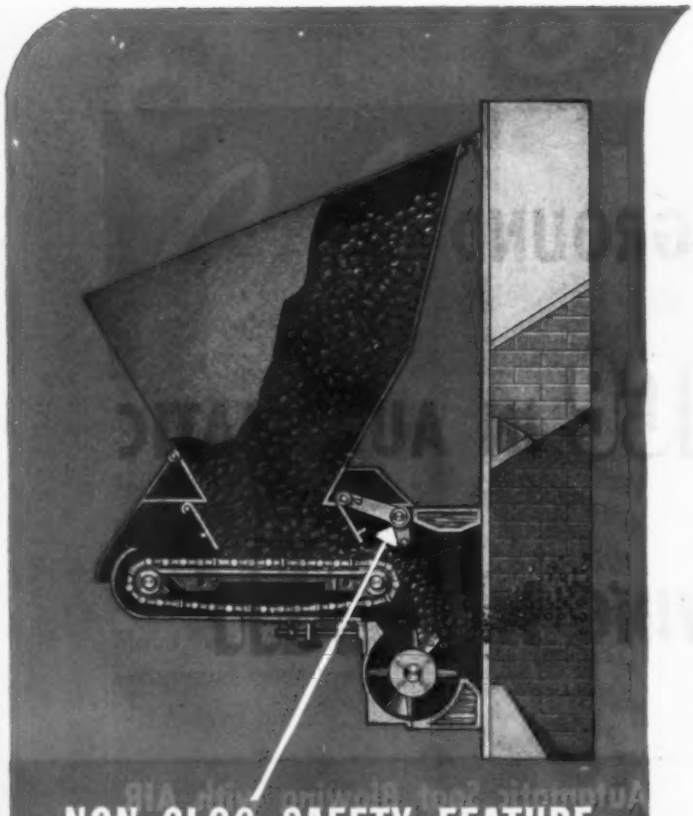

BURNS ALL KINDS OF SOLID FUEL

WHY WORRY ABOUT coal availability and prices? Here's a stoker that efficiently burns so many kinds and grades of solid fuels, that you can easily keep up with changing conditions while producing more steam at lower cost.

It's the Æ Perfect Spread Stoker, a compact, completely automatic fuel-firing unit for high or lowest grade coals, coke breeze or sawdust. You can even burn corn cobs, hogged fuel, wood refuse, plant refuse and by-products for still greater economy.

This dependable, extremely quiet-running stoker has many more features that may fit perfectly your present and future needs. Because its advanced design is "streamlined" in appearance, principle and operation, it also "streamlines" your fuel bills and boiler room practices. Be sure to get *all* the details. Write today for the Æ Perfect Spread Stoker bulletin.

NON-CLOG SAFETY FEATURE PREVENTS JAM-UPS

Tramp iron and other foreign objects in your fuel won't jam up and damage the Æ Perfect Spread Stoker. Small objects pass right through onto the grate, while infrequent larger pieces stop the feeder without harm. The feeder can be cleared and started again by simply lifting the cover and making a minor adjustment—without special tools—without removing the mechanism. This exclusive Non-Clog Safety Feature gives you quiet, uniform operation and non-stop firing.

Cooperate with the "National Fuel Efficiency Program" of the U. S. Bureau of Mines.

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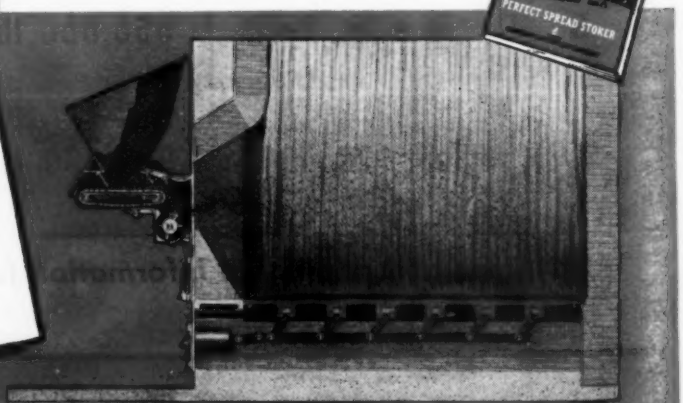

Other Æ Products: Æ-Taylor Stokers, La-Bel Boilers, Marine Deck Auxiliaries, Bole-Shaw Fuel Preps, Diamond Face Grinders

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SAVE on POWER COSTS

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You may find the answer to your specific problems in the improved Taylor Stoker—a stoker with many new features and advantages supplementing its time-tested and proved principles of combustion. Each of these improvements is worth studying in detail . . . for details often mean the difference between choosing a stoker for the job, and choosing the *best* stoker.

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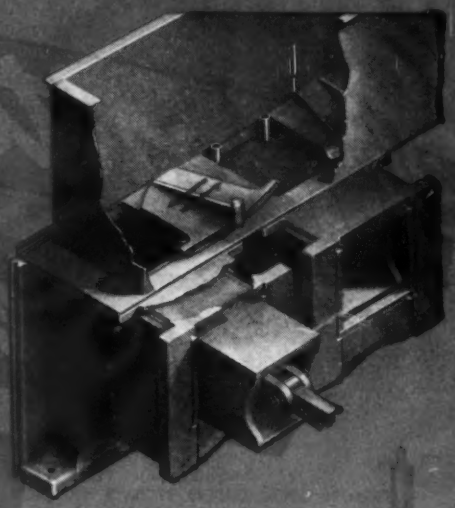
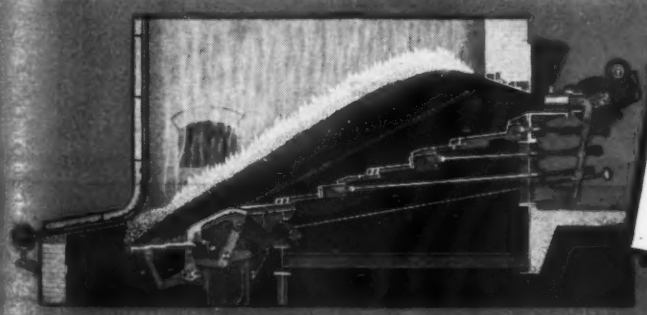
ANOTHER IMPROVEMENT IN THE TYPE "R" TAYLOR STOKER



AGITATOR PREVENTS B-R-I-D-G-I-N-G IN COAL HOPPER

Wet or partially frozen coal is prevented from packing and "bridging" in the stoker hopper by unique agitators. Operated by alternating strokes of the coal rams, a series of oscillating agitators located between the rams prevents bridging and keeps coal flowing. Each coal ram gets a *full* charge *every* stroke and a uniform fuel bed is maintained.



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AIR-COOLED & WATER-COOLED

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Bed Hoists, Marine Deck Auxiliaries, Dole-Shaw Fluid Power, Diamond Face Grinders

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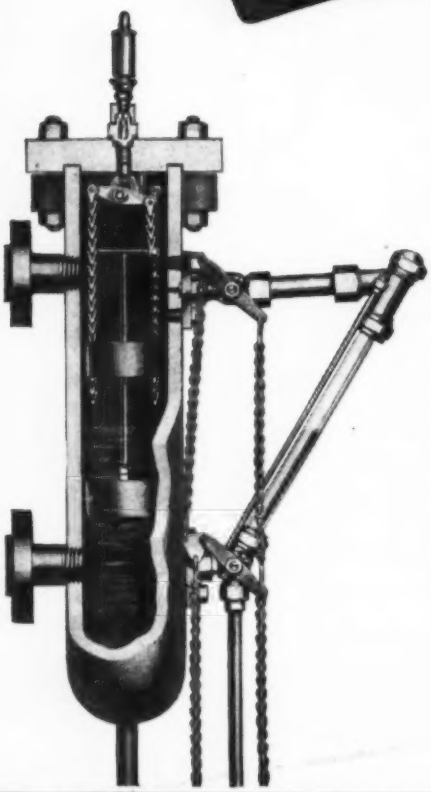
A YARWAY COMBINATION

Positive Boiler Water Level Protection



Why do so many power engineers insist on Yarway boiler trim? Because Yarway Water Columns and Gages, Remote Liquid Level Indicators and Yarway Blow-Off Valves give *positive* boiler protection.

Outstanding example is the Yarway Floatless Hi-Lo Alarm Water Column which provides instant warning by steam whistle of any dangerous deviation from normal boiler water level. Alarm mechanism employs *solid weights* which operate on the displacement principle . . . can *never* become waterlogged. Column is shown at left with Sesure Inclined round glass Gage for low and medium pressures. Column with Vertical flat-glass Gage for higher pressures is shown at right. Yarway Columns and Gages are fully described in Bulletin WG-1810.

Investigate the complete Yarway line of boiler trim for your plant. It's a sound investment in boiler protection.

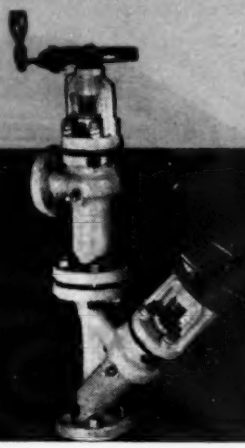
YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Pa.

Ask about the new Yarway 30-minute color and sound motion picture, with Lowell Thomas speaking—available for group showings.

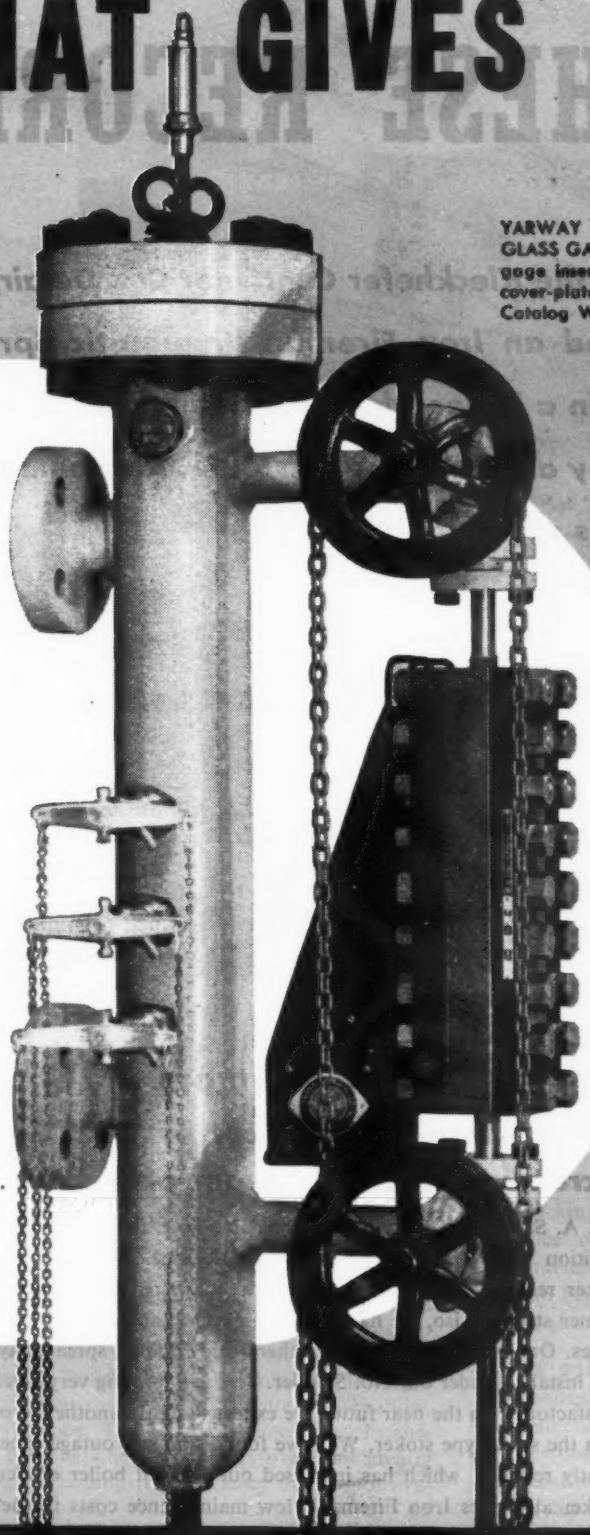
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND SESURE INCLINED GAGE, for pressures up to 400 psi. Sesure Inclined Gage gives easier reading of water level from below. Ask for Catalog WG-1810.

YARWAY UNIT TANDEM BLOW-OFF VALVES, built for pressures up to 2500 psi. Combining a Seatless sealing valve and a Hard-Seat next-to-boiler blowing valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit.



YARWAY SEATLESS TANDEM BLOW-OFF VALVES—standard in over 12,000 plants—for pressures to 600 psi. Famous balanced sliding plunger design with non-clogging, straight-through flow. No seats to score, wear and leak. Described in Catalog B-432.

THAT GIVES



YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND FLAT-GLASS GAGE, for pressures up to 1500 psi. Pressure-sealed flat-glass gage inserts are mica protected and have patented, spring-loaded cover-plates which prevent excessive strain on glass. Ask for Catalog WG-1810.

YARWAY REMOTE LIQUID LEVEL INDICATOR for pressures up to 1500 psi, brings boiler water level indication down to instrument panel or other convenient eye-level location—right in front of your eyes, on a brilliantly-lighted scale. Operated by the boiler water itself, using the pressure differential between a constant head of water and the varying head in the boiler drum. Ask for Catalog WG-1820.

YARWAY STEAM PLANT EQUIPMENT

COMPARE THESE RECORDS

In 1941 the Kieckhefer Container Co., Delair, N. J., installed an Iron Fireman Pneumatic Spreader Stoker in a boiler which has been fired for several years by another type of stoker. The comparative record is shown below:

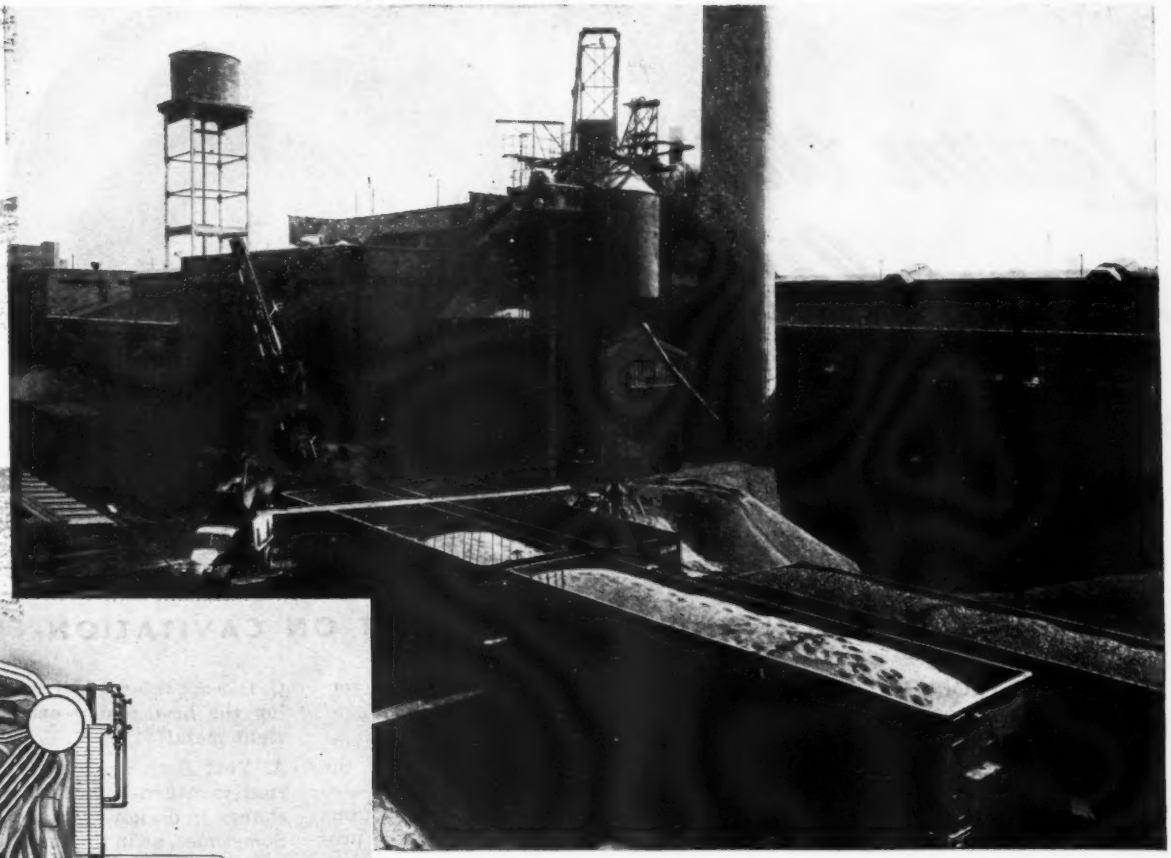
		Former Stoker	*Iron Fireman Pneumatic Spreader Stok*
STEAM PRODUCTION	AVERAGE	31,500 lbs. per hour	40,000 lbs. per hour
	MAXIMUM	36,000 lbs. per hour	50,000 lbs. per hour
ANNUAL COAL COST		$95,300	$76,940
MAINTENANCE PER YEAR		$1,700	$150

A. S. Barker, chief engineer
Kieckhefer Container Co.

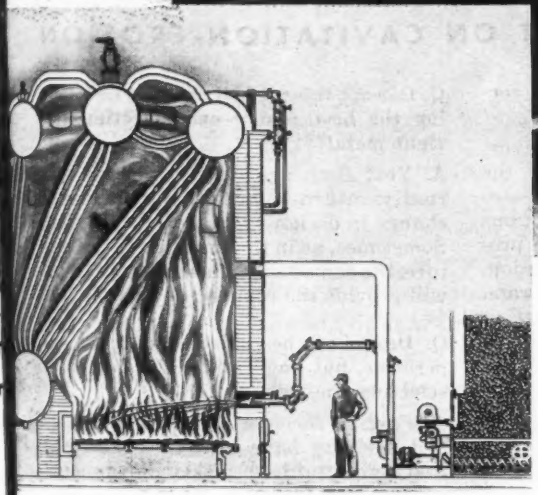
Iron Fireman saves $19,910 a year in fuel and maintenance, a cut of 20.5%, while increasing average steam production 27%.

Mr. A. S. Barker, Kieckhefer's Chief Engineer, lists other advantages in addition to lower steam costs. Says Mr. Barker: "The Iron Fireman stoker responds much more rapidly to the demand for steam than the former stoker. Also, we have noticed a considerable reduction in ash pit losses. On January 11, 1945, another Iron Fireman spreader type stoker was installed under our No. 5 boiler. This is operating very efficiently and satisfactorily. In the near future we expect to equip another of our boilers with the same type stoker. We have found that our outage time has been greatly reduced, which has increased our over-all boiler efficiency." Mr. Barker attributes Iron Fireman's low maintenance costs to the fact that there are no mechanical parts exposed to furnace temperatures.

Heavy Duty Pneumatic Spreader Stokers



Power plant of the Kieckhefer Container Co., Delair, N. J., which equipped one boiler with an Iron Fireman stoker in 1941 *and is gradually adding others.*



Typical Iron Fireman Pneumatic Spreader installation in bent tube type boiler. This model feeds direct from main bunker, eliminating manual coal handling or mechanical coal conveying systems. Forced draft air supplied by separate fan unit, not shown.

THE IRON FIREMAN PNEUMATIC SPREADER STOKER

meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

There is an Iron Fireman for every Industrial Firing Need

Iron Fireman stokers have served American industry for more than 20 years, having been successfully applied to almost every conceivable type of firing job, in many thousands of installations. There is an Iron Fireman for every firing need.

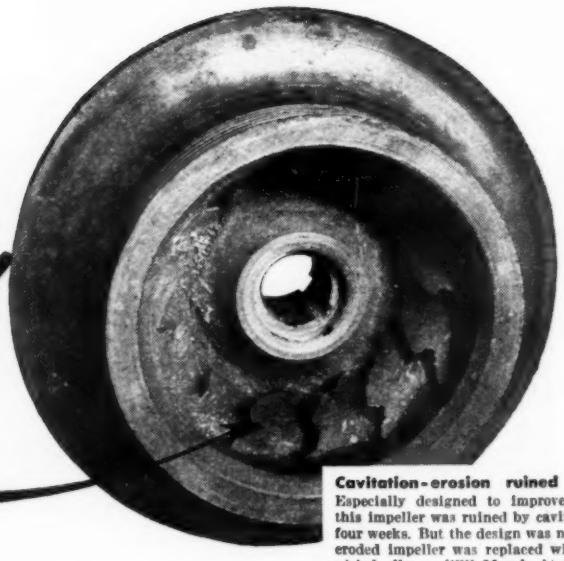
Iron Fireman advantages include: 1. More efficient combustion, which cuts fuel consumption; 2. Ability to burn low grade coals efficiently; 3. Backing of a thoroughly competent and experienced engineering staff and service organization, which insures correct installation and effective maintenance; 4. Automatic controls which regulate fuel and air to the steam demands and maintain high efficiency and uniform steam pressure over the full load range.

FREE SURVEY. Iron Fireman's nation-wide sales, service and engineering organization will upon request make a survey of your boiler room, in conjunction with your own engineers if you so desire. This survey will give you valuable information on the efficiency of your plant, and will involve no cost or obligation on your part. For survey or technical literature write to Iron Fireman Manufacturing Company, 3844 West 106th Street, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada

IRON FIREMAN

THE IRON FIREMAN

Learn the story behind this damage



Cavitation-erosion ruined these blades. Especially designed to improve pump efficiency, this impeller was ruined by cavitation in less than four weeks. But the design was not abandoned. The eroded impeller was replaced with one made of a nickel alloy — "S" Monel. At last check, it was still in service after 2½ years — over a 3000% improvement!

A 5 MINUTE QUESTION AND ANSWER DIGEST ON CAVITATION-EROSION

THE PROBLEM

Q. What is meant by cavitation-erosion?

A. Cavitation-erosion (or simply "Cavitation") is the type of erosion caused by collapse of tiny bubbles in a liquid, with consequent hammering of the liquid against the metallic surface.

Q. Where may cavitation be encountered?

A. The inertia of a rapidly-moving liquid makes it tend to continue in a given direction rather than to follow the contours of the metallic surface over which it is flowing. This may create voids. The rush to fill them causes the cavitation. In power plants, for example, it is a particularly destructive phenomenon.

Q. Are these voids a complete vacuum?

A. No, the space is filled with vapor from the liquid and with dissolved gases that may be present.

Q. What causes the damage?

A. When the voids collapse, there results a pounding by the fluid comparable to the destructive force of tiny bullets impinging against the metallic surface. With thousands of voids collapsing every minute, the cumulative result is powerful enough to cause deformation and fatigue, and to remove films which might inhibit corrosion.

Q. How are cavitation and corrosion related?

A. Corrosion intensifies cavitation; and cavitation accelerates corrosion. Thus, a self-sustaining chain of destruction exists.

Q. How does corrosion intensify cavitation?

A. The roughened surface of a corroded metal affords greater opportunity for the formation and the collapse of voids.

Q. How does cavitation accelerate corrosion?

A. With many metals the initial corrosion rate is very rapid. However, the speed of the attack usually decreases due to the formation of protective films of the corrosion products. If these protective films are removed by cavitation, corrosion proceeds at an abnormal rate. *That is why use of corrosion-resisting metals and alloys is so important!*

THE REMEDY

Q. What important factors govern control of cavitation?

A. Laboratory and field studies indicate that the most important factors are:—

1. Proper design.
2. Resistance to corrosion fatigue.
3. Resistance to corrosion and freedom from pitting.
4. Tenacity of protective films, and speed of new film formation.
5. Strength, hardness, and ability of a metal to withstand over-stressing and to distribute locally-applied stresses.
6. Susceptibility to strain hardening.
7. Uniformity of grain structure.

Q. Why is design so important?

A. Poor design (inadequate streamlining) has proved to be the leading single cause of cavitation. And, its effect is intensified by a high velocity liquid flow.

Q. Doesn't this all boil down to developing the best design and selecting the right metal?

A. Yes! Both are very important and really interdependent. Sometimes a change in design will reduce cavitation. Sometimes, as in the impeller in the picture, the same design in a different metal will provide the remedy. *Consider both!*

Q. Design can be guided by skill and experience, but how can one be guided in selecting the right metal?

A. *Past performance!* Laboratory tests and field use have for years indicated that a group of high-nickel alloys should be considered wherever cavitation-erosion is a possibility.

Q. What is this group?

A. The corrosion-resisting INCO Nickel Alloys — nickel, Monel, "K" Monel, "H" Monel and "S" Monel. Their resistance to cavitation has been amply demonstrated by their successful use to replace other metals in high-speed propellers, pump impellers, hydraulic valves, agitators and in similar parts.

Q. Can INCO Nickel Alloys be used to build up parts that have already suffered cavitation-erosion?

A. Yes, and this ability is a big help on many repair jobs. For example, deposition of Monel or "K" Monel by arc-welding is an excellent way to build up eroded steel parts.

Q. How can more help be obtained on combating cavitation-erosion?

A. The International Nickel Company, Inc. has compiled a large amount of information on cavitation and will make all this accumulated experience available to anyone who needs it. Write: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

Reprints of this advertisement are available upon request from The International Nickel Company, Inc.

Now UP TO 2000 hp!

STANDARD 2000-HP TRI CLAD MOTORS NOW AVAILABLE

THEY GIVE EXTRA PROTECTION 3 ways

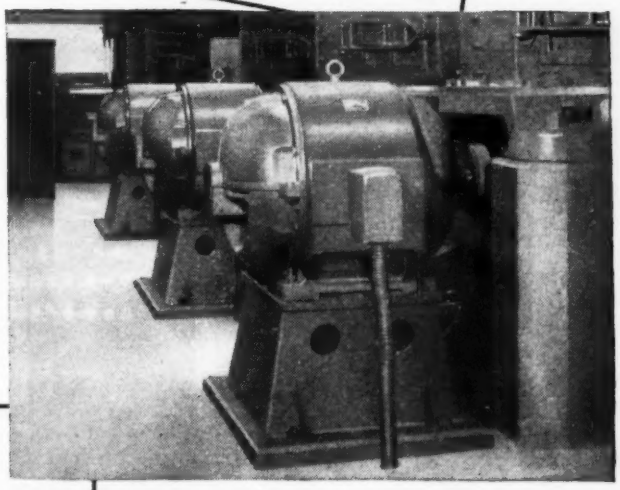
1 Extra protection from physical damage—Cast-iron construction. Upper portion completely enclosed. Streamline, cast-iron end shields. Corrosion-resisting finish.

2 Extra protection from electrical breakdown—Windings of Formex* wire, strongly bonded with oil- and moisture-resistant synthetic resins, stand up under abrasion or "heat-shock."

3 Extra protection from operating wear and tear—Sleeve or ball bearings, in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad bearing proportions, with cast-in "air seal" to further insure oil tightness of the housing.

The triple-protected construction that has made General Electric's Tri-Clad motor so popular in the small and intermediate sizes has now been extended to motors of 2000-hp capacity. On your *big* drives, these new Tri-Clad motors will meet severe conditions with greater assurance than ever of dependable service and long life.

The Tri-Clad motor, in its wide range of types and sizes, is industry's most popular integral-hp motor. Chances are there's a standard Tri-Clad to meet your requirements "on the nose." For information on G.E.'s complete line of Tri-Clad motors, ask for Bulletin GEA-3580. *General Electric Company, Schenectady 5, N. Y.*



Three of the new, large Tri-Clad motors, each rated 200 hp, 1200 rpm, driving coal pulverizers in a Southern steam-electric plant

*Trade-mark reg. U.S. Pat. Off.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES

TRI CLAD Type K	—1 hp to 2000 hp at 1800 rpm
TRI CLAD Type KG (High starting torque, low starting current)	—5 hp to 200 hp at 1800 rpm
TRI CLAD Type KR (High starting torque, high slip)	—Available to 100 hp in speeds required for high-slip, flywheel drive (punch press, etc.)

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

TRI CLAD MOTORS

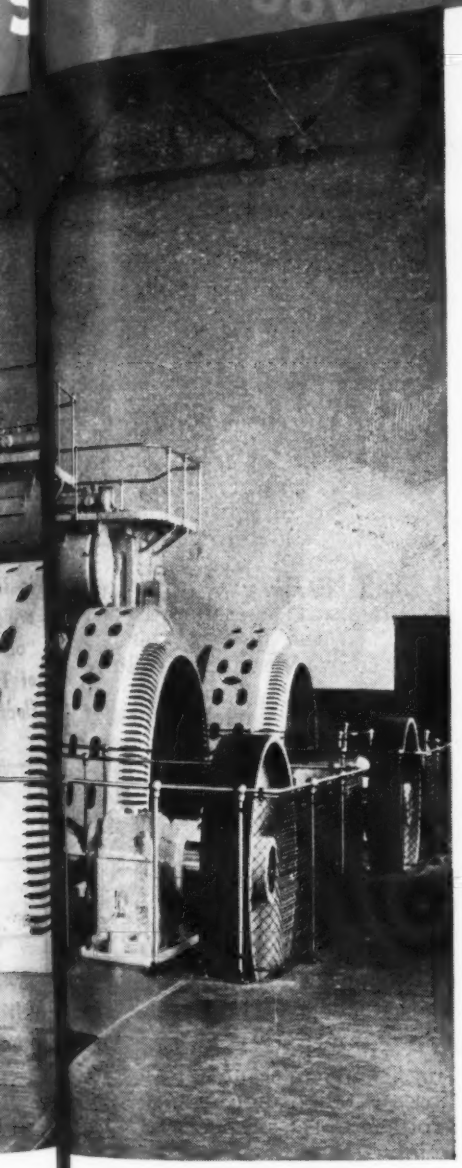
TUNE IN THE
TEXACO STAR THEATRE
WITH JAMES MELTON
EVERY SUNDAY NIGHT
—CBS

TEXACO

REG. T. M.

TEXACO

Use the oils that . . . ★ Keep rings free, valves active, ports clear
★ Assure complete piston seal
★ Protect modern bearings
★ Prevent scuffing, greatly reduce wear
★ Prevent varnish and sludge



YOU are assured these outstanding benefits when you use Texaco Ursa Oils because—

Texaco Ursa Oils are typical examples of petroleum products improved through The Texas Company's constant research. Their production is 100% Texaco controlled from well to finished product. Crudes, carefully selected for their ability to assure efficient and economical Diesel operation, are processed by modern Texaco methods in a most efficiently equipped, up-to-the-minute refinery . . . and absolute uniformity is assured by the constant supervision of an army of skilled and experienced technicians.

These are some of the reasons why *Texaco Ursa Oils* are approved by all leading Diesel engine manufacturers, and why—

More stationary Diesel hp. in the U. S. is lubricated with Texaco than with any other brand.

Texaco Lubrication Engineers specializing in Diesel lubrication are available to you upon request. Get in touch with the nearest of more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

FOR EVERY TYPE OF DIESEL

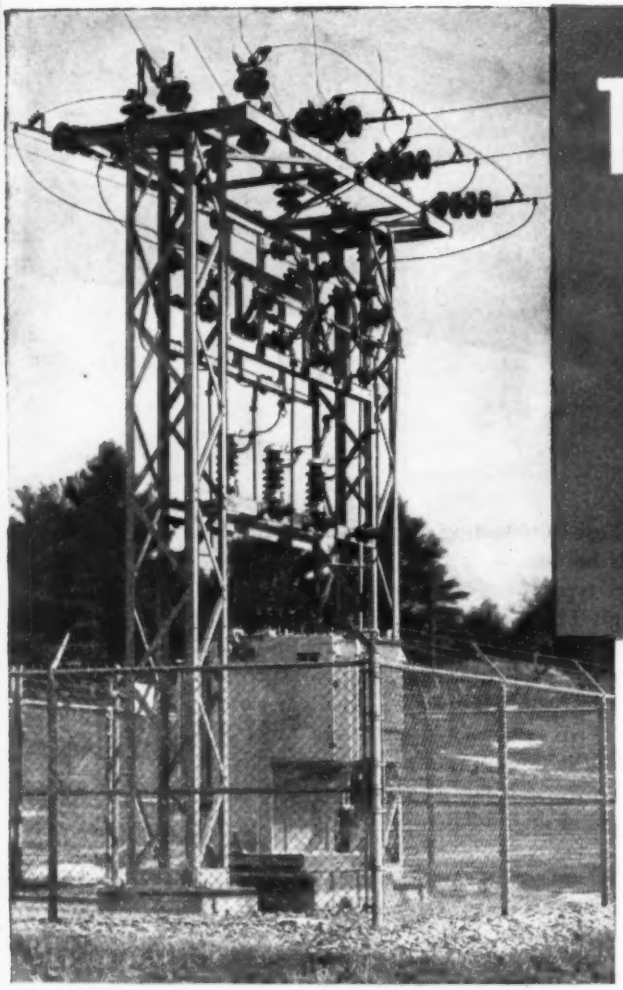
Effective lubrication of a Diesel engine calls for an oil especially designed for the particular type of engine and the service for which the engine is built. To meet this requirement, The Texas Company, in step with improvements in Diesel engine design over the past thirty years, has developed a *complete line* of Texaco Ursa Oils . . . one to meet the requirements of every type and size of Diesel, from the smallest high-speed portables to the largest stationary and marine installations. When a Texaco Lubrication Engineer recommends a particular grade of Ursa, you can be sure it is the *right* oil for maximum efficiency and minimum fuel consumption.

URSA OILS

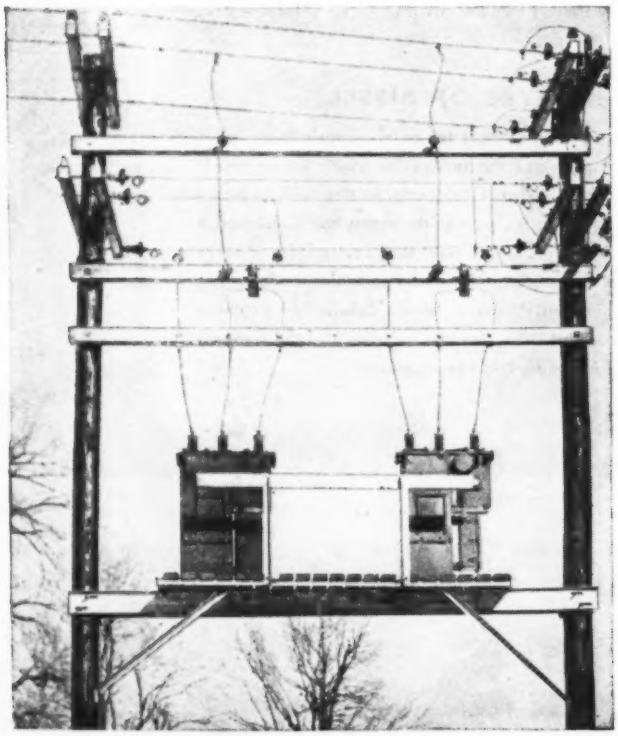
FOR ALL DIESEL ENGINES

The RIGHT VOLTAGE at

Here's every type of regulator you need, to have the right voltage—anywhere



STEP REGULATORS (MLT-32)—For urban and rural circuits 69,000 volts and below. Provide 10% regulation raise *and* lower in thirty-two 5/8% steps. Ratings 104 to 750 kva, three-phase.



BRANCH STEP REGULATORS (ML-4)—For very low-cost regulation; 10% raise or lower in four 2½% steps on 2400-, 4800-, and 6900-volt feeders. Up to 51.8 kva, single-phase.

● It is now easy and inexpensive to extend the benefits of good voltage to every point of your distribution system—or to every nook and corner of your plant. Whether you need voltage regulation for urban feeders, rural lines, factory circuits, or laboratory, there is a simple, economical G-E device for the job.

A few ways these devices may be able to help you:

ON PRIMARY CIRCUITS

1. As an aid in maintaining service standards and keeping customer good will in the face of wartime distribution problems. Also, to iron out feeder-voltage problems.

2. To find "hidden kilowatts" (by releasing extra system capacity) without revamping present lines or adding new feeders. They're a "natural" for voltage problems that must be solved quickly. They make possible more effective use of equipment already on a system.

3. To make your system capacity more adaptable for postwar loads. Sudden shifts in population, drops in wartime loads or increased domestic and commercial loads can be taken care of more easily—often without changing generator or transmission facilities.

4. To reduce system costs. Actual case histories show annual savings of from $834 to $9950 on a single feeder.

ON SECONDARY CIRCUITS

1. For improved lighting (more constant light level); for better starting of fluorescent lighting; for increased lamp life;—by holding voltage at the proper level.

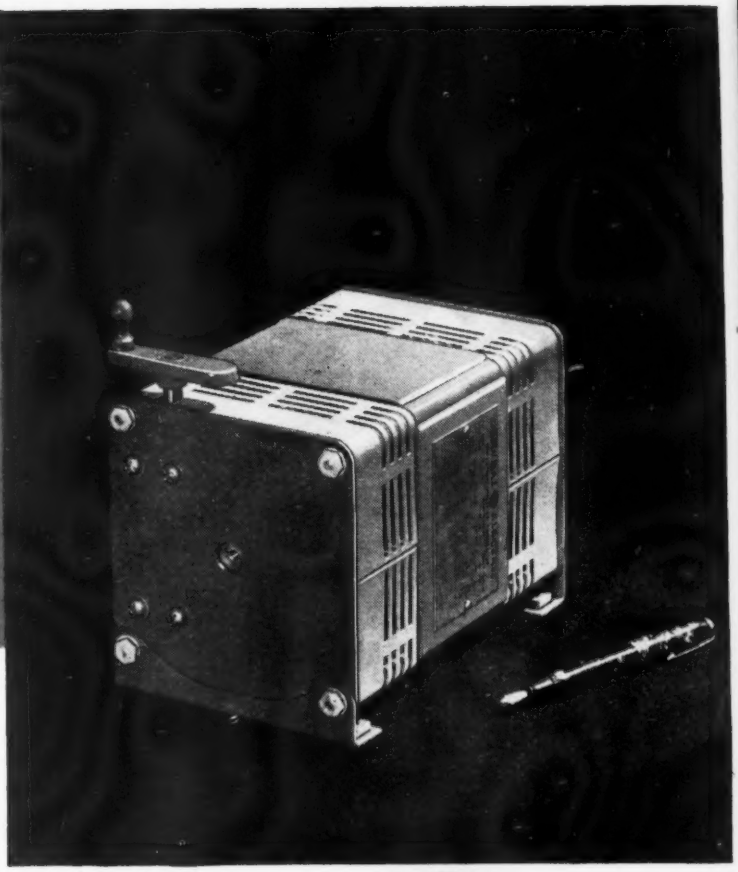
2. For greater production—by eliminating sluggish operation of motors and potential or control devices.

3. For longer life of electric equipment; for protection of precision electric devices, electronic tubes, etc;—by reducing overheating and burnouts.

4. For the right voltage in your laboratory to assure accurate test results in less time.

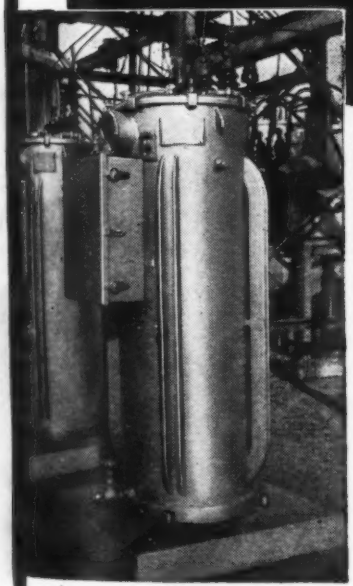
The regulators shown at work on these pages are only representative of the many G-E voltage-improvement devices that are available to help you. We shall be glad to help you analyze your voltage problem to determine what corrective measures are necessary. *General Electric Company, Schenectady 5, N. Y.*

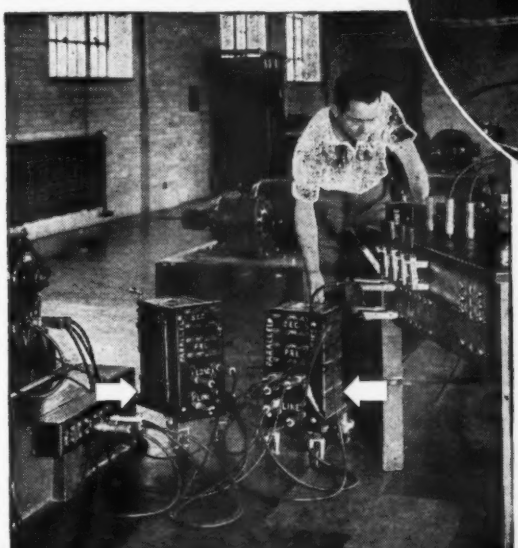
the RIGHT PLACE Does the Job BETTER



SMALL DRY-TYPE REGULATORS—For 120- and 240-volt circuits. 10% raise and lower or 100% raise and lower regulation. Up to 600 va, single-phase. 10% ratings available for automatic operation.

VOLTAGE STABILIZERS—Automatically provide a constant 115- or 230-volt supply to a given load, on circuits varying from 95 to 130 or 190 to 260 volts. Ratings from 50- to 5000-va output.





VARIABLE-VOLTAGE AUTOTRANSFORMERS — Provide smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243- to 810-va output for 115- and 230-volt circuits.

INDUCTION REGULATORS (IRS —oil-type or Pyranol for indoor or outdoor use)—Provide 10% regulation raise and lower on 2400-, 4800-, and 6900-volt feeders. 12 to 120 kva, single-phase. Also available three-phase.

DRY-TYPE REGULATORS (AIRS)—For secondary circuits. *Automatic type:* Provides 10% regulation raise and lower. *Remote-motor or hand-operated:* 100% raise and lower. Up to 12 kva, 600 volts, single-phase. Also available three-phase.

GENERAL ELECTRIC

IN EVERY TYPE OF INDUSTRY

Nothing reveals the universal character of the VU Steam Generator better than a list of the industries where it is in operation bringing higher standards of efficiency to plants requiring boiler capacities from as little as 20,000 lb of steam per hr to as much as 300,000 lb per hr. Moreover, this comprehensive spread of industrial applications accompanies an equally significant geographical distribution, with VU installations not only in the United States and Canada, but also in Latin America and such remote regions as Russia, China and Arabia.

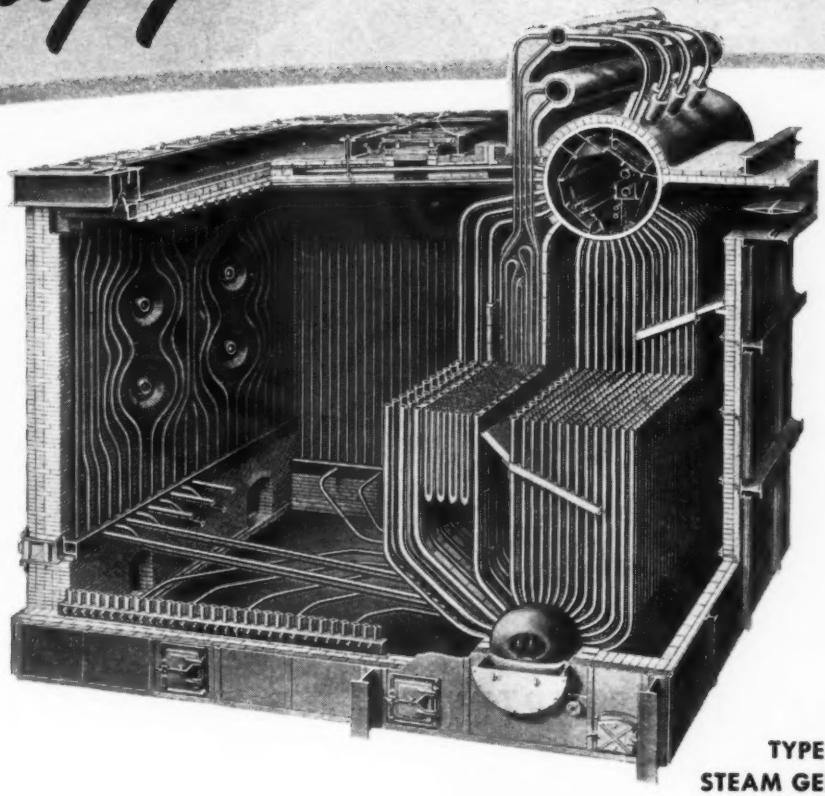
Airplane Engines	Department Stores	Paper & Paper Board
Asphalt	Distilleries	Public Utility
Automobiles	Electrical Equipment	Refrigerators
Breweries	Explosives	Railways
Building Materials	Food Products	Radio
Car Building	Linoleum	Rubber
Carpeting	Leather Goods	Steel
Cement	Locomotives	Sugar
Chemicals	Meat Packing	Textile
Coal Mining	Metal Working	Tobacco
Coke	Mining	Universities
Confectionery	Non-ferrous Metals	U. S. Navy Department
Dairy Products	Oil Refining	U. S. War Department

C-E

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

in application



TYPE VU
STEAM GENERATOR

FOR EVERY TYPE OF FUEL AND FIRING

Another evidence of universal character is the versatility of the VU Unit with respect to fuels, a quality which means there are no geographic limitations of its application. It is supplied for burning pulverized coal, oil, gas or any combination of these fuels. It is also adaptable to firing with every basic type of stoker which means that it can be employed for any type of coal. C-E supplies the equipment for all of these methods of firing bringing the customer a coordinated installation designed for high efficiency performance . . . in the range from 80 to 88 percent.

FOR A WIDE RANGE OF CONDITIONS

The VU Unit is designed for a wide range of steam conditions. Installations range in capacity from 20,000 to 300,000 lb of steam per hr. Design Pressures are from 200 to 1000 psi and Total Steam Temperatures range up to 900F.

• • •

This impressive record of VU acceptance in all branches of industry is reason for your special consideration of this modern unit for your next boiler installation.

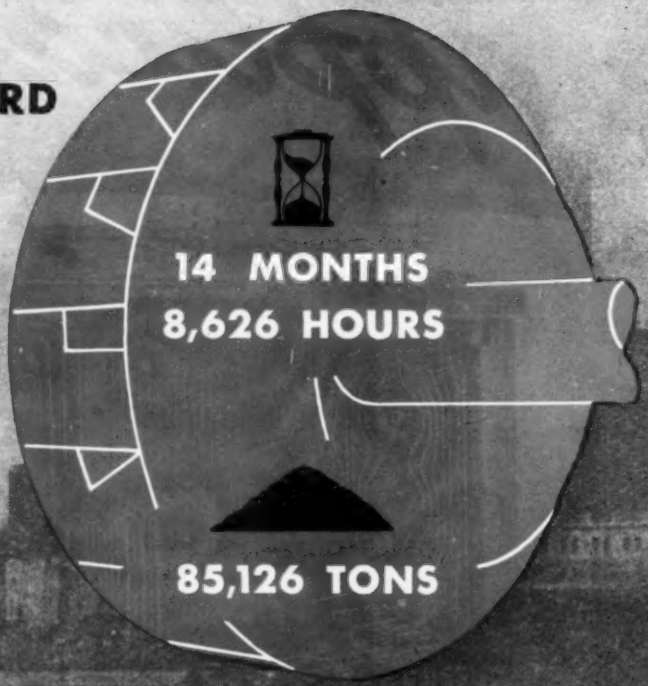
A-898

ENGINEERING

200 MADISON AVENUE NEW YORK 16, N. Y.

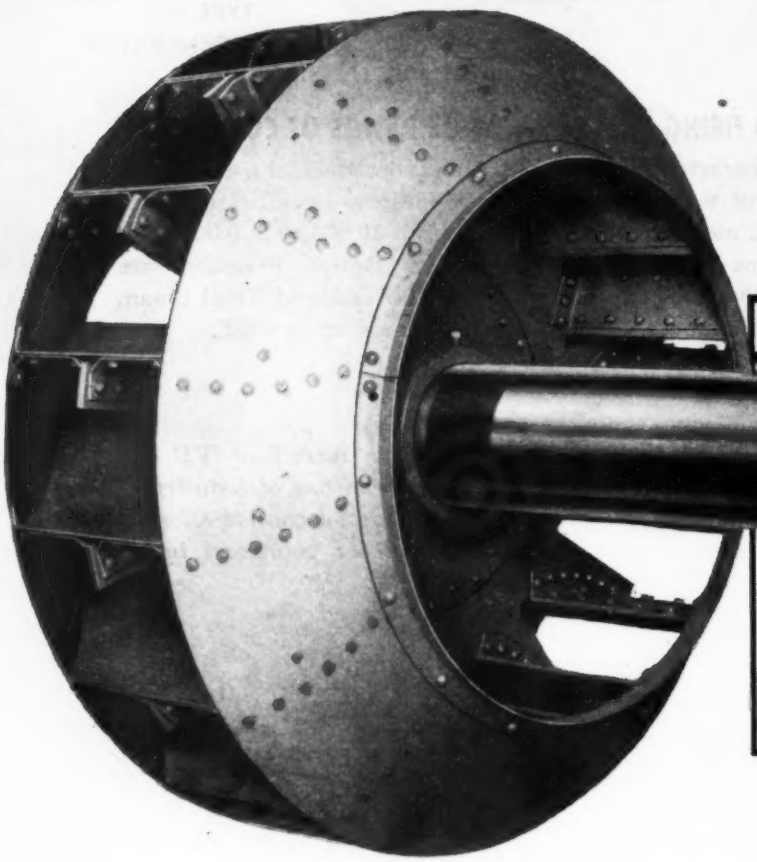
A PERFORMANCE RECORD

STANDARD WHEEL



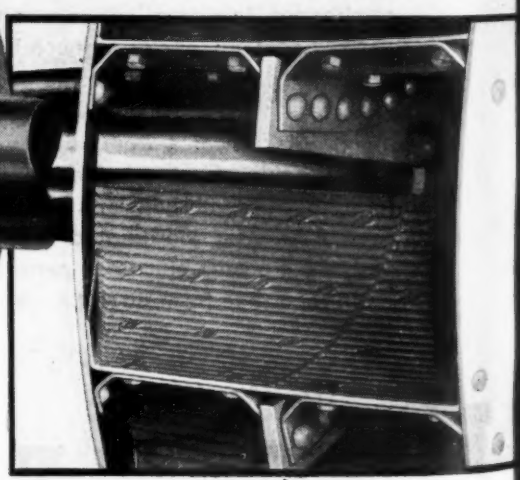
Thanks to the cooperation of the engineers at Columbia Park Station, of Cincinnati Gas & Electric Co., we are able to present this factual case study.

HERE'S WHY THE STURTEVANT E-R WHEEL STANDS UP...

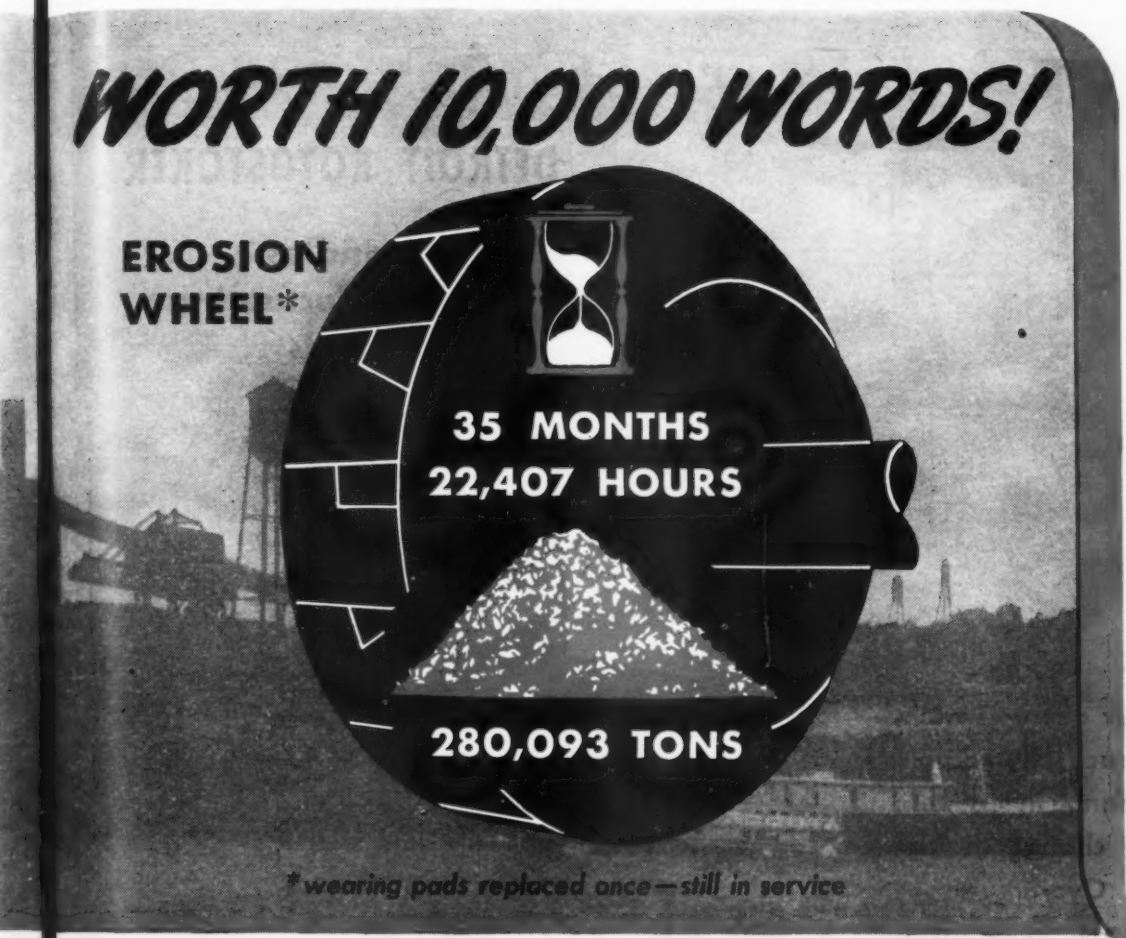


Concentrated streams of fly ash from both inlets attack each other—*and not the wheel*—because center plate is cut away between blades, giving fly ash no toe-hold for its destructive work.

These special ribbed liners armor your wheel against the abrasive action of fly ash. Instead of renewing a whole wheel you merely replace these liners — easily, quickly and at much less cost.



WORTH 10,000 WORDS!



HEATING

VENTILATING

AIR CONDITIONING

DRYING

MECHANICAL DRAFT

DUST AND FUME CONTROL

HERE ARE REPORTS FROM OTHER USERS...

"Our policy is to try to buy equipment that will not wear out. 22 months' operation with Erosion Resisting Wheels makes us feel we were successful in this respect."

★

"Before the war, fan wear was not a problem. But under wartime fuel conditions, wheels began to go in 1 year. Maintenance costs alone justified our buying Erosion Resisting Wheels."

"Once a year we had to repair our wheels. Erosion Resisting Wheel life is from 50 to 100% greater. Repairs are only a fraction of former repair costs."

★

"Standard wheels wore through in 9 to 12 months. Erosion Resisting Wheels last 15 to 18 months. This experience also prompted another company in our industry to specify Erosion Resisting Wheels."

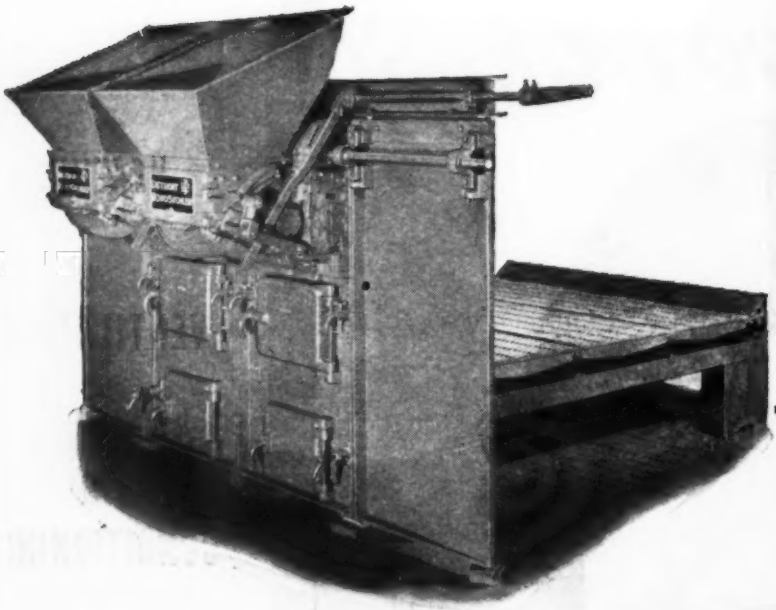
Abrasion of fan wheels by fly ash—always a problem—becomes increasingly severe as capacity ratings rise. That's why Sturtevant developed this special Erosion Resisting Wheel.

EXACTLY HOW MUCH BETTER IS IT? That "pictograph" gives you a typical record made under severe fly ash conditions.

Here, as in scores of plants, this Sturtevant achievement in fan engineering steps up the *life expectancy of induced draft fan wheels from 2 to 4 times!* The exclusive Sturtevant design makes fly ash *fight itself.* Even under the most severe fly ash conditions, this makes possible new standards of fan performance. So, whatever your particular yardstick of fan wheel efficiency—measure the results you're now getting against the experience of users cited here. They're typical of what you, too, may expect with Sturtevant Erosion Resisting Wheels.

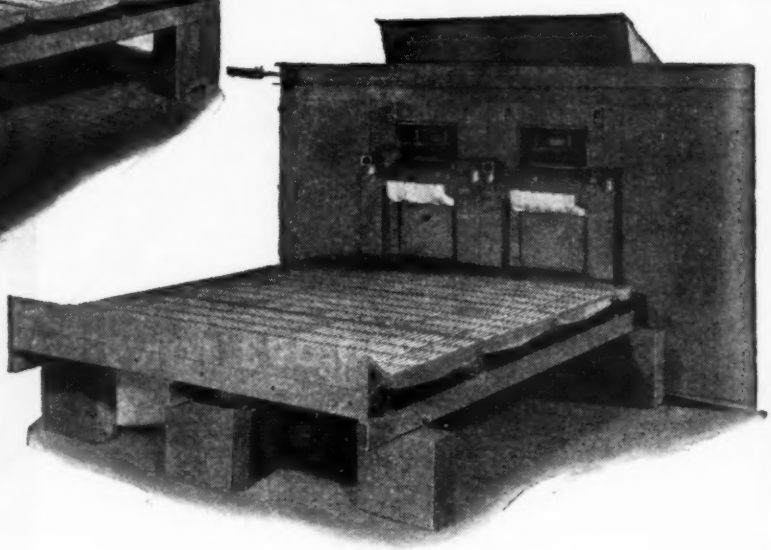
B. F. STURTEVANT COMPANY
Hyde Park Boston 36, Mass.

Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work



DETROIT ROTOSTOKER

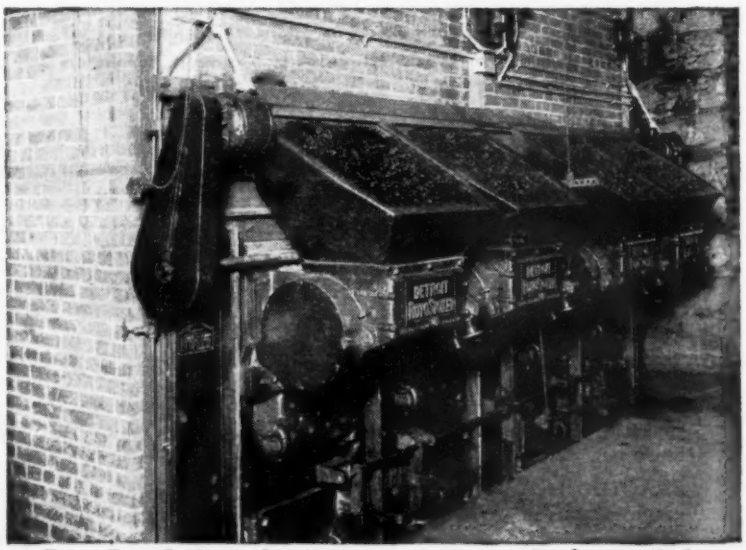
Handles Widely Fluctuating Loads



Detroit RotoStoker operates automatically with practically no time loss between a change in load and a corresponding change in fuel and air supply. Overfire air in proper proportion to undergrate air is introduced. Furnace turbulence takes place with a thorough mixing of the products of combustion that produces high carbon dioxide (CO_2) and correspondingly high efficiency at all ratings.

OVERTHROW ROTORS produce uniform fuel distribution. Fuel bed on the grates is comparatively thin and is penetrated by numerous air streams that cool the ash between the grates and the fire, to protect the stoker ironwork.

Detroit RotoStoker ready for inspection and shipment. All Detroit Stokers are assembled at the Works.

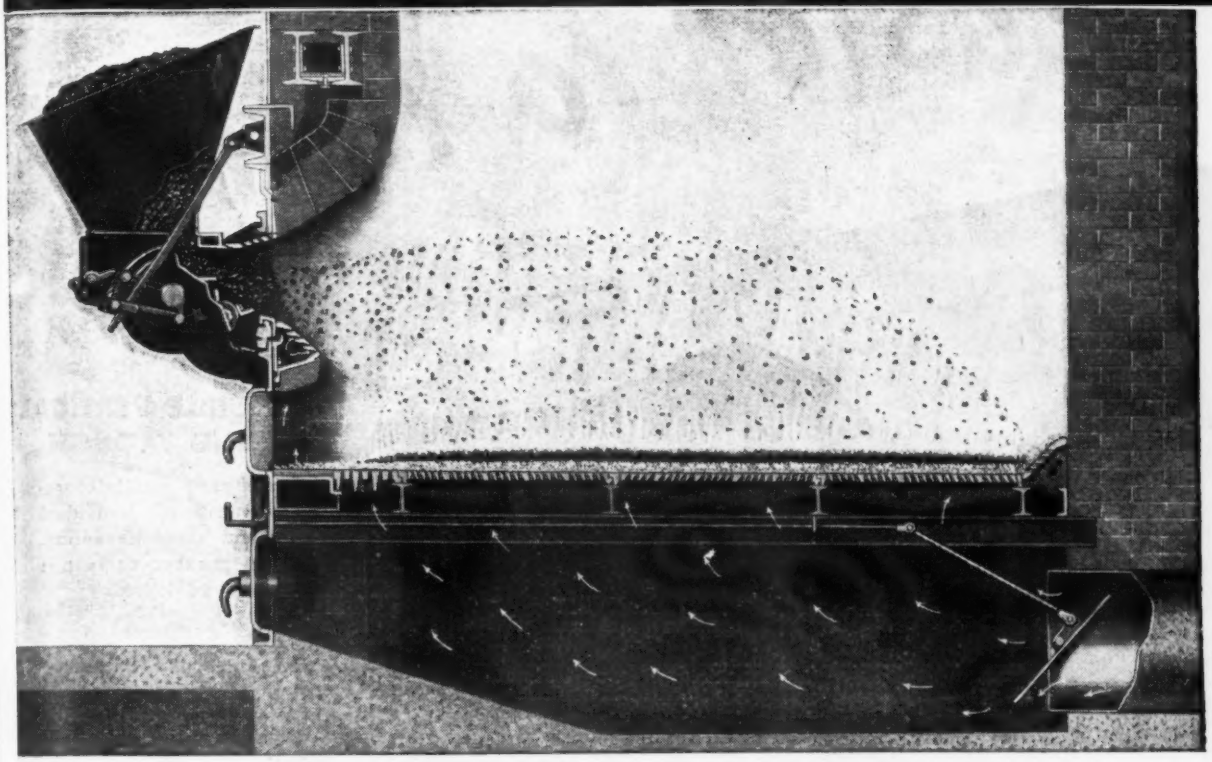


Two RotoStokers (stationary grate type) of two Rotors each with 180 horsepower boilers.

DETROIT STOKER COMPANY

Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan
District Offices in Principal Cities • Built in Canada at London, Ontario

DETROIT ROTOSTOKERS—BURN A WIDE RANGE OF FUEL

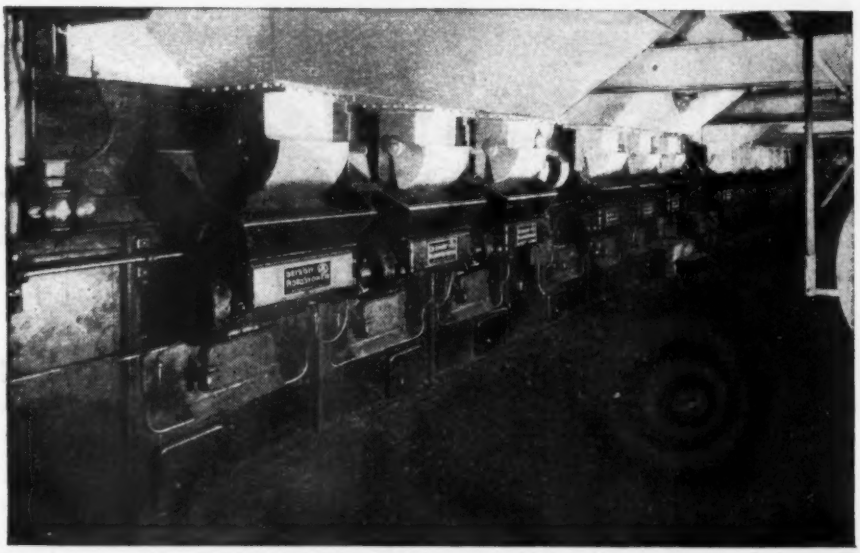


DETROIT ROTOSTOKER (Stationary Grate Type). Fine particles of fuel are burned in suspension and the coarse coal on the grates. OVERTHROW ROTORS produce uniform fuel distribution with a thin fuel bed.

Detroit RotoStokers successfully burn a wide range of fuel without special fuel preparation. Responsive to changes in load, under automatic control, they maintain uniform steam pressure. Compact in design. Heavily built for years of continual hard service. Popular among Engineers and easy to operate. Hundreds installed in all parts of the United States and Canada.

Showing four of six Roto-Stokers having three Rotors each, total eighteen Rotors, for which three contracts were received. Operated by a nationally known Shipbuilding Company.

The number and width of Rotors of each RotoStoker is varied to suit the boiler furnace width and capacity desired.



DETROIT STOKER COMPANY

Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan
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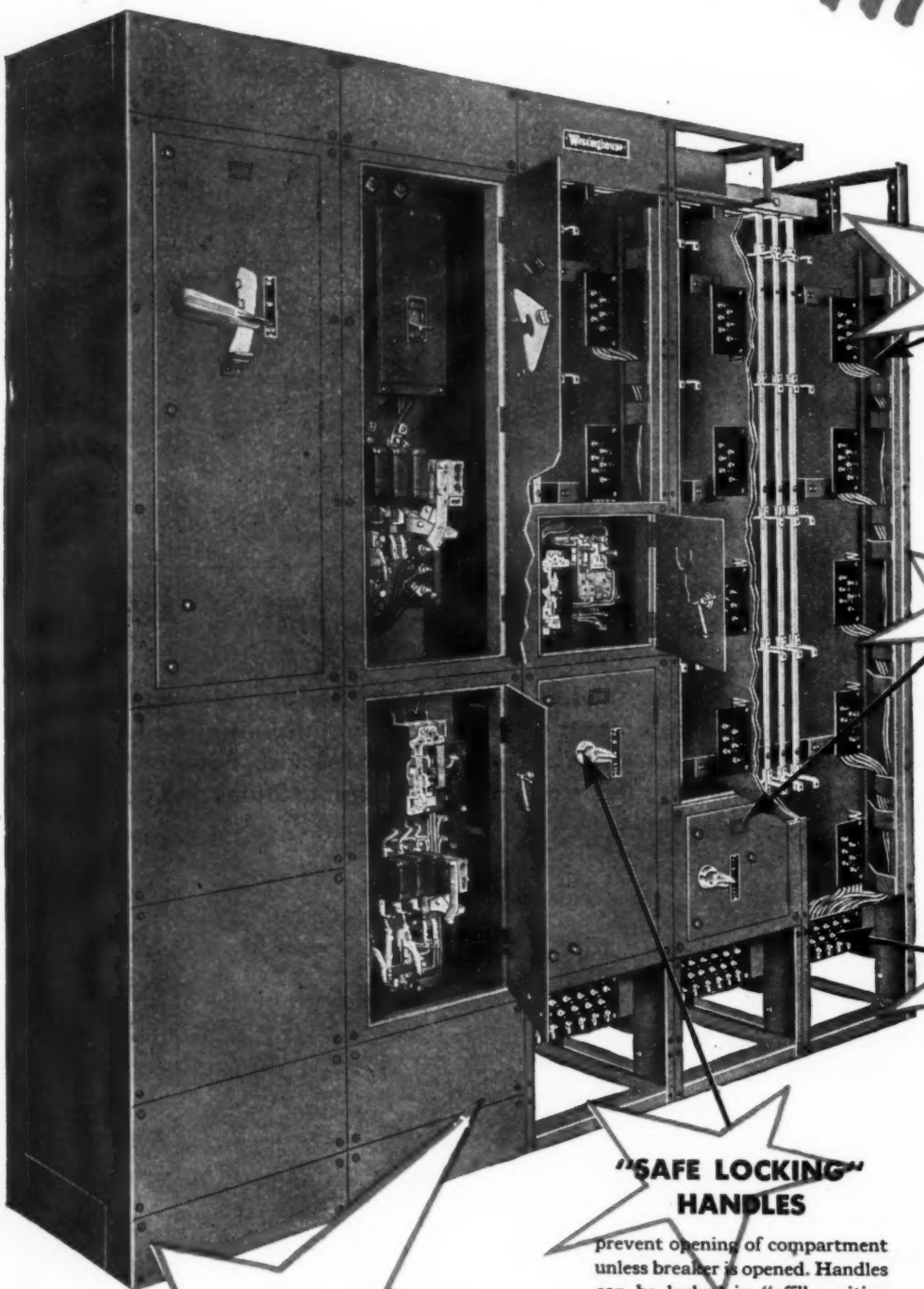
Easier to install



ACCESSIBLE VERTICAL WIRING TROUGH

in each unit facilitates rearrangement of individual units and simplifies wiring, should master terminal boards not be desired.

STARTER UNITS EASILY REMOVED

from front of structure for relocation or maintenance—provides new operating flexibility.

MASTER TERMINAL BOARD

conveniently located at bottom (or top) of a control center, simplifies connection of outgoing leads. Individual terminal boards make wiring easy to identify, simple to change—connections between starters and master terminal boards made at factory.

"SAFE LOCKING" HANDLES

prevent opening of compartment unless breaker is opened. Handles can be locked in "off" position with from one to three padlocks.

FRONT OR BACK-TO-BACK MOUNTING

. . . twice the number of units can be installed without increasing depth of structure when back-to-back mounting is employed.

FOR ANY CONTROL CALL WESTINGHOUSE

WESTINGHOUSE

easier to maintain...

Application and operating flexibility of Westinghouse Control Centers saves man-hours in installation... and maintenance ... saves space with diversity of mountings.

A big reason why Westinghouse Control Centers are easier to install and maintain is simplicity of design. It simplifies control center problems from planning, ordering . . . down to the last item of maintenance. Regardless of the diversity of ratings required in one structure, a Westinghouse Control Center (built from standardized units) is available. There are three basic reasons for this flexibility:

1. *Standardized dimensions* of the main structure and of individual units. Size 1, 2, 3 and 4 linestarters are mounted in the same sheet steel structure—only section heights vary.
2. *Standardized terminal board system* simplifies wiring because all internal connections are made at factory—all outgoing connections are conveniently located on master terminal board at top or bottom of starter.
3. *Individual starter units* or sections can be rearranged quickly. Units can be installed anywhere in the structure, in any combination.

Because of this complete standardization... of every part... Westinghouse Control Centers result in much lower over-all cost than made-to-order multimotor control panels. These are only a few advantages of standardized prefabricated Westinghouse Control Centers. All units are standard Westinghouse control items . . . offering the benefit of the half century of Westinghouse control experience. For information, write your Westinghouse office. Ask for Booklet B-3026. Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-60599

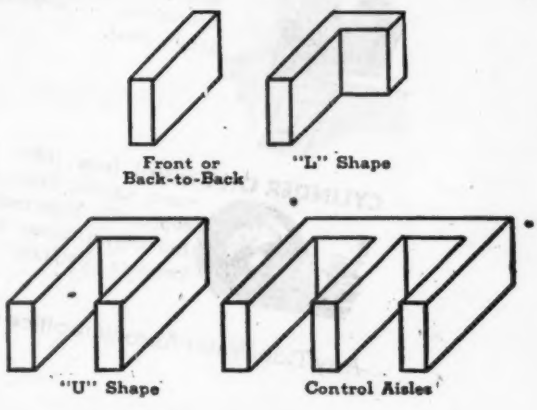
ALL INDIVIDUAL UNITS EASILY REMOVED

It's easy to remove an individual unit —a self-contained combination linestarter (circuit breaker and magnetic across-the-line starter)—just remove line and load leads and loosen four corner screws on trim. Entire unit then slides out for inspection or replacement. Each unit is completely baffled.

Only Westinghouse Control Centers Offer All These Advantages:

- Full installation and operating flexibility—all units 20 inches wide.
- Simplified maintenance, because of centralized, easily accessible controls.
- Smart, modern appearance.
- Standardized structures, permitting easy addition of control units.
- Full mounting flexibility. Starters can be mounted front only, or back-to-back.
- Complete operating safety assured by "safe locking" handles.

TYPICAL ARRANGEMENTS POSSIBLE WITH WESTINGHOUSE CONTROL CENTERS



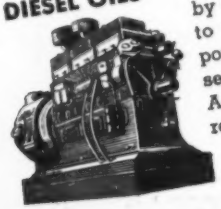
Westinghouse CONTROL CENTERS

TURN TO TYCOL "Engineered

ENGINEERED SOLUTIONS TO YOUR LUBRICATION PROBLEMS *at your fingertips*

Tycol lubricants are made in a comprehensive line to meet each specific service requirement. Their performance-proved lubricating ability is the result of modern scientific engineering and rigid testing. The line includes:

DIESEL OILS of 100% paraffine base, refined by the most modern processes to eliminate unstable compounds that would oxidize in service. There is a Tide Water Associated Oil for every Diesel requirement.



SPECIALIZED INDUSTRIAL LUBRICANTS for all types of machinery in all types of industry — from steel to textile.

GREEN CAST GREASES, made from paraffine base cylinder oil with a minimum of soap . . . extremely economical, giving greater lubrication per pound than do conventional greases.

TURBINE OILS with great stability and resistance to emulsification . . . free from sludge-forming hydrocarbons . . . engineered to inhibit Rust.

VEEDOL MOTOR OIL, refined from 100% Pennsylvania Crude by Tide Water Associated's triple-refining process, which produces that tough "film of protection" — famous all over the world.

CYLINDER OILS refined from 100% Pennsylvania Crude. They have exceptionally high resistance to breakdown under high temperature operation.

Any Tide Water Associate office will help you select the oil or grease best suited to your needs.

Drums! Drums! Drums!

War needs make it imperative that all empty drums be returned immediately.

INDUSTRIAL TYCOL OILS-GREASES

TYCOL INDUSTRIAL

ENGINEERED FOR EVERY

Lubrication"

FOR GREATER SERVICE...LONGER LIFE

from *everything* that *TURNS!*

All equipment will last longer — give better service — if the proper lubricant is used. That's why you will find it profitable to use Tycol oils and greases.

There's a reason! No matter what your lubricating need — extreme pressure*, high or low temperature, high speed, or any other service condition — there's a Tycol Oil or Grease scientifically engineered exactly to suit your specific requirements.

Refined from the highest grade crudes, Tycol lubricants are exceptionally resistant to breakdown which means greater economy . . . longer machine life for every type of equipment.

Tide Water Associated engineers will gladly recommend the Tycol lubricant that meets your particular requirements. Call, write or wire your nearest Tide Water Associated office today.

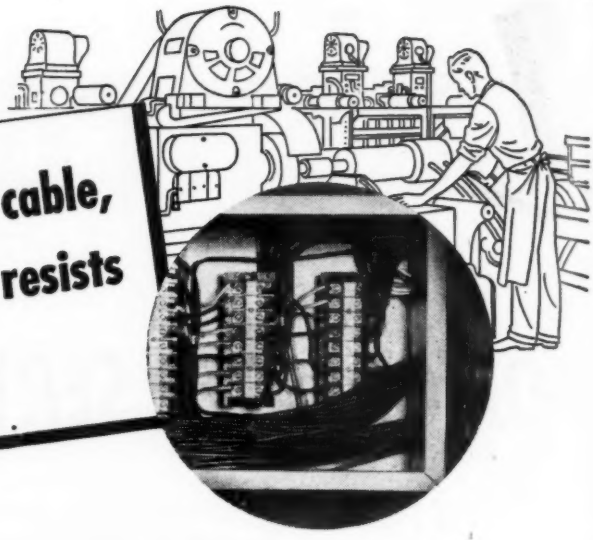
Makers of the Famous VEEDOL Motor Oil

***EXTREME PRESSURE!** For clear, concise descriptions of the basic tests used to determine important lubricant properties — Viscosity, Pour Point, Extreme Pressure and many others — consult Tide Water Associated's informative handbook "Lubricania". For your FREE copy write: Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

LUBRICANTS
ERVICE NEED

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

PRINCIPAL OFFICES
BOSTON · PHILADELPHIA
PITTSBURGH · CHARLOTTE, N.C.



PROBLEM: to find insulated cable, for wiring machine tools, which resists all kinds of cutting fluids

First solved with FLAMENOL *cable*

● Not long after the introduction of Flamenol*, in 1935, a prominent manufacturer of automobiles was searching for insulated cable which would withstand machine-tool cutting oils and coolants. When a G-E sales engineer showed the manufacturer a sample of Flamenol—and described its excellent resistance to oils, water, and heat—the company's chief electrician immediately ordered 6000 feet. The company found this cable so satisfactory that it now specifies Flamenol to be installed on all the machine tools it buys. If you have a problem of finding insulated cable or wire that will withstand severe conditions, such as contact with cutting fluid, Flamenol may very likely be the answer. It has proved its many desirable properties in hundreds of power and lighting applications.

RESISTS FLAME—Flamenol does not support combustion. Thus, it prevents serious outages due to fires that involve wiring. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Flamenol's insulation strips easily and leaves the conductor surface untarnished. It is highly resistant to oils, water, mild acids and alkalis, and weather. It is tough, stable, and flexible at low temperatures, and has high dielectric strength.

A G-E "FIRST"—Only G.E. makes Flamenol wire and cable. Flamenol is the pioneer of wire and cable insulated with plasticized polyvinyl chloride. It was produced by G.E. in 1935—not as a substitute for rubber-insulated wire, but as a new type possessing desirable properties not available with rubber. To find out how Flamenol can help solve your problems—save you time, trouble, and expense—ask our local office, or write General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

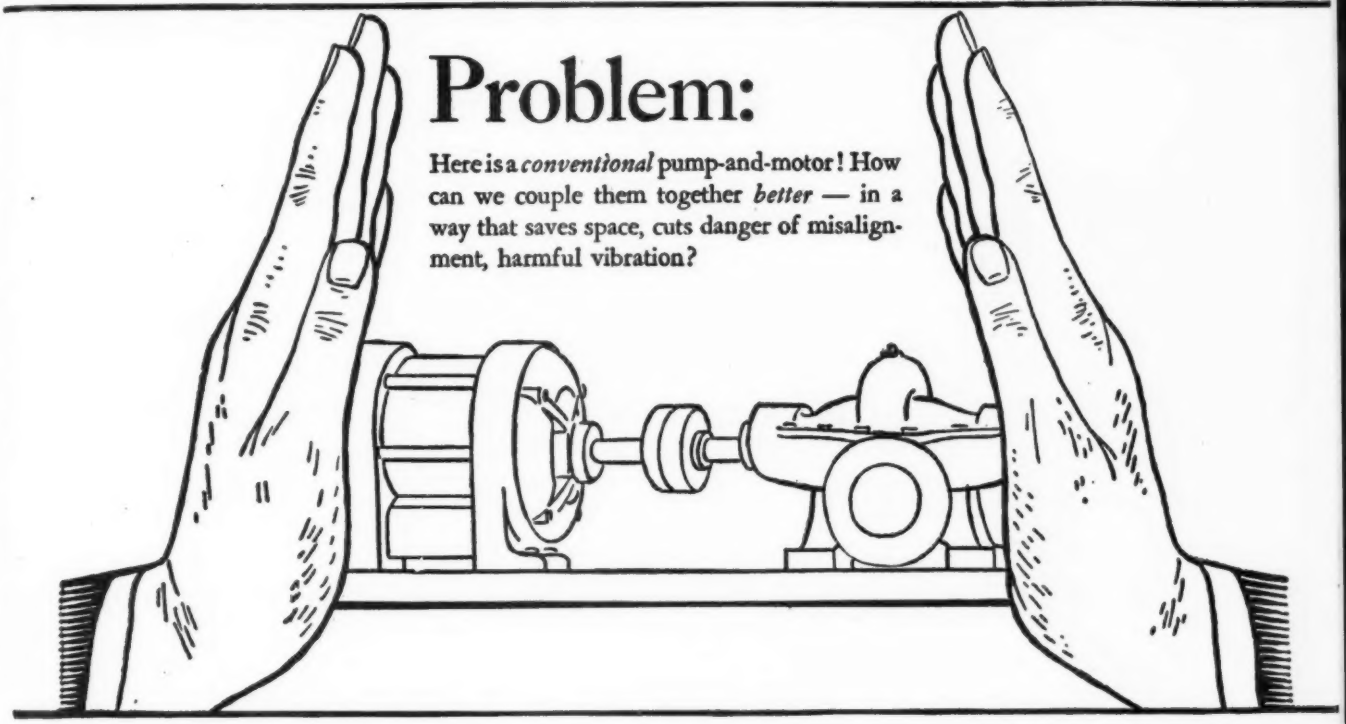
GENERAL ELECTRIC

503-52-1206

Buy all the BONDS you can—and keep all you buy

Squeeze Play

SOLVES PUMP PROBLEM!



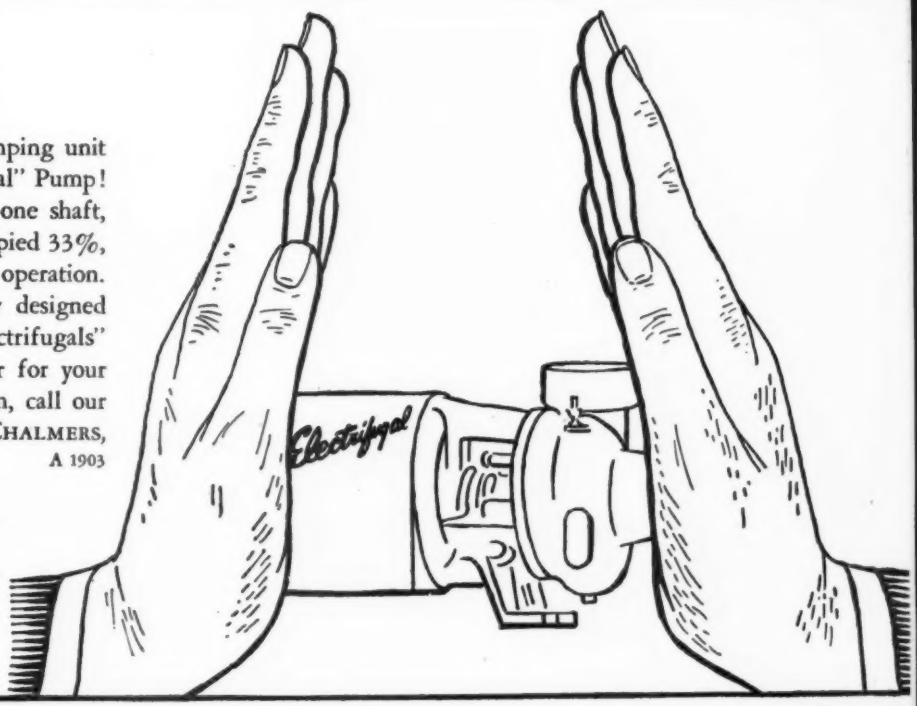
Problem:

Here is a *conventional* pump-and-motor! How can we couple them together *better* — in a way that saves space, cuts danger of misalignment, harmful vibration?

Solution:

We design a *new kind* of pumping unit — the one and only "Electrifugal" Pump! Motor and pump are now on one shaft, one frame. That cuts space occupied 33%, assures alignment and smooth operation. Splash-proof motor is specially designed for pump drive. No wonder "Electrifugals" give you more pumping power for your money! For further information, call our nearby office, or write ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1903



ALLIS CHALMERS *ELECTRIFUGAL* PUMPS

Reconversion Problems? Write A-C for free Reconversion Inventory Kit for all makes of pumps, motors, V-belts!

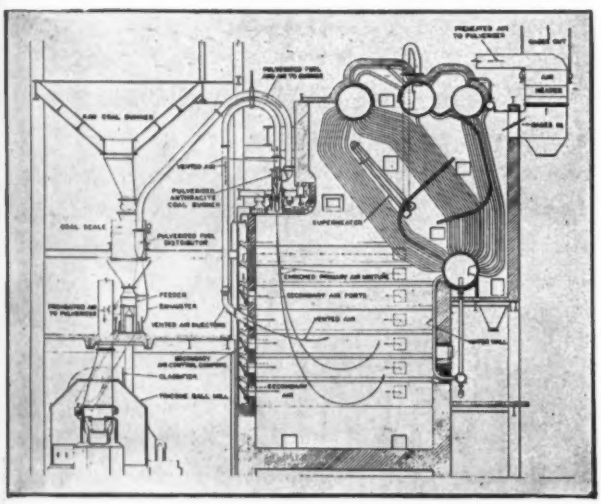
Blazing THE

DIRECT FIRING of

1935

The first Direct Fired Installation of Pulverized Anthracite was made in a large New Jersey paper mill in 1935.

Six more industrial installations have since been made to fire pulverized anthracite with this same FW system in capacities up to 175,000 lb. of steam per hour.



Important savings have been realized from the use of low grade anthracite and a new source of fuel has been made available.

FW FOSTER

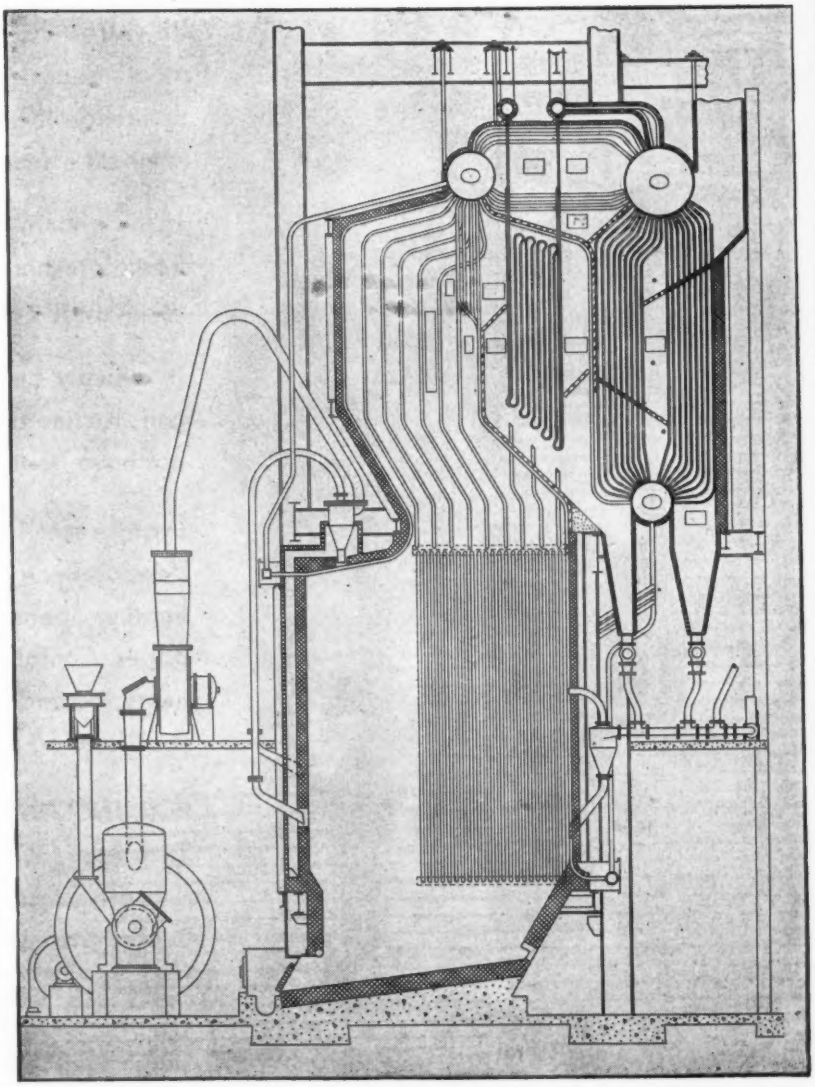
ENGINEERING TRAIL

Pulverized ANTHRACITE

1945

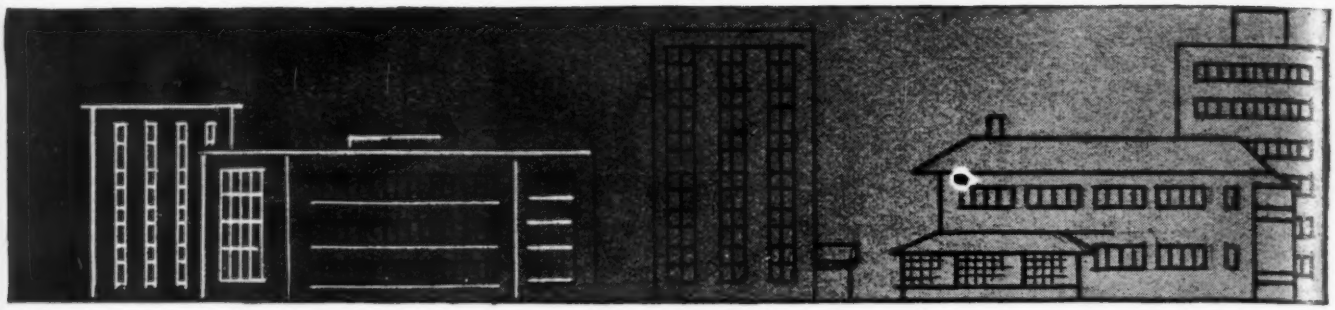
First Central Station Steam Generator for the Direct Firing of Pulverized Anthracite Coal.

Two Units for the Hunlock Creek Plant of the Luzerne County Gas & Electric Co. for 175,000 lb. per hour of steam each.



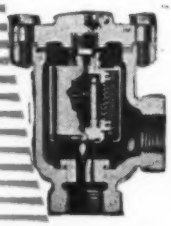
FOSTER WHEELER CORPORATION
165 BROADWAY • NEW YORK 6, N. Y.

WHEELER FW

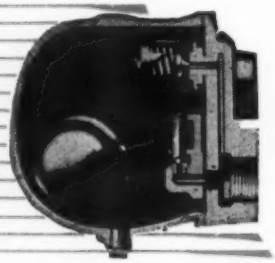


TOMORROW'S

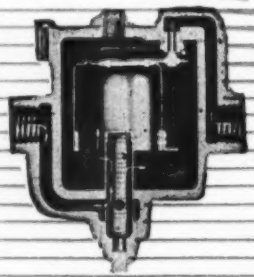
BETTER . . . .



THERMOSTATIC STEAM TRAP



FLOAT-THERMOSTATIC STEAM TRAP



BUCKET STEAM TRAP

87 TRAP-CONTROL

If you are responsible for heating performance and heating costs in a theatre, commercial or industrial building—the chances are that you can increase the over-all efficiency 10 to 25%.

If the system was installed more than ten years ago—Sarco's technical developments and improvements alone would justify modernization.

If recently built—it was probably engineered for rush construction and the right steam traps and control may not have been available at the time.

In any event, it will pay any engineer to go over the latest developments in Sarco Products as a check against his heating operations. A few examples are given on these pages. Complete data in the Sarco Bulletins. Sarco Engineers located in all large centers are ready to inspect your heating system, without obligation.

FOR INSTANCE, the new Sarco Thermostatic Steam Trap has double its former capacity to discharge condensate or air. It now has the power and speed of a bucket trap—and greater efficiency.

FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

Represented in Principal Cities

SARCO

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y.

HEATING • • •

AND AT LOWER COST

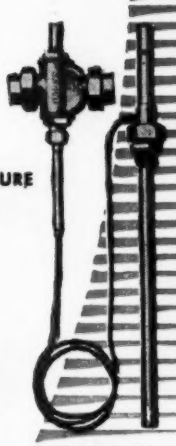
SARCO FLOAT-THERMOSTATIC and Bucket Traps have been still further perfected and ranges extended. A variation of the float trap is now used as a liquid level control.

THE SARCO 87, a low cost trap-control is now made in many forms—for tank control and out-door heater lines and tanks (it can't freeze).

THE SARCO TR-21 temperature control for hot water heating and process work is complemented by a series of rigid stem controls for heaters, tanks and scores of new applications. KR-14, its companion control for air and gases, has been improved.

SARCO WATER BLENDERS, now made in three types, serve all purposes from individual showers to engine cooling jackets. And the Sarco TR-40 cooling control is saving up to 50% of the water used on compressors, degreasers, and condensers.

Other developments too numerous to mention are illustrated in the Sarco Hook-Up Book and the Sarco Bulletins. Ask the nearest Sarco representative to make up a set applying particularly to your conditions.

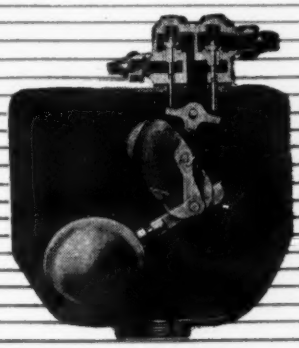


TR-21 TEMPERATURE CONTROL

WATER BLENDERS

TR-40 COOLING CONTROL

KR-14 TEMPERATURE CONTROL



ALTERNATING RECEIVER

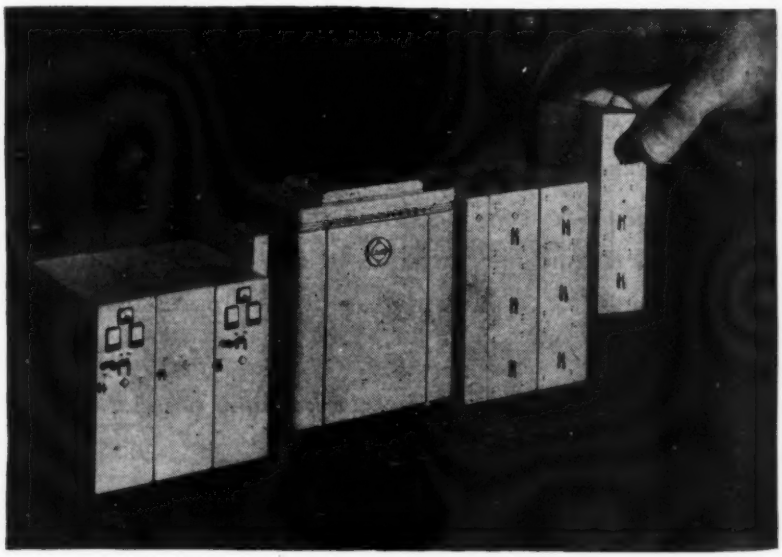
Saves Steam

•Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

121

Here's what you

Here's how you



1 YOU SEE WHAT'S AVAILABLE — without bogging down in tables, charts, diagrams. Accurately constructed—½ in. to 1 ft — models eliminate all guesswork in unit substation planning. And they're idea-stimulating . . . hard to keep your hands off.

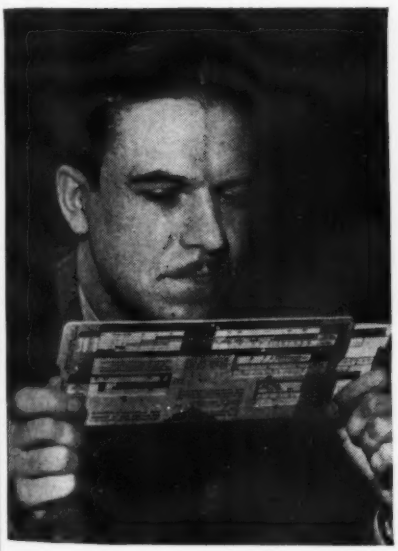
2 YOU EXPERIMENT. Unit substation arrangements are assembled quickly . . . allowing easy comparison of alternate plans. Thirty-eight models permit you to see for yourself the great flexibility of Allis-Chalmers unit sub equipment . . . determine the *right* substation for your plant. A field engineer from your nearby A-C district office will be glad to show the models. There's no obligation.

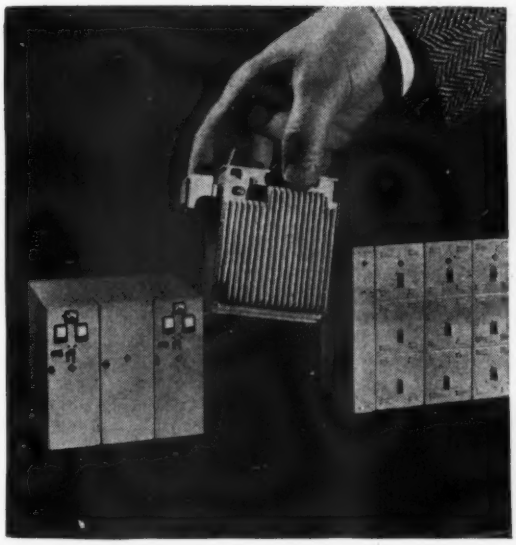
SEE YOUR UNIT SUB IDEAS WORKED OUT WITH ALLIS-

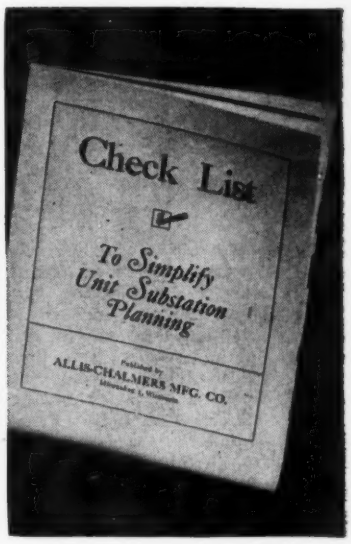
have to work with

work:

When you use Allis-Chalmers scale models to help solve Unit Sub problems!







3 **YOU DETERMINE** what size circuit breakers will be needed when you use Allis-Chalmers' handy Unit Sub Slide Rule to calculate secondary short circuit current quickly, easily, accurately.

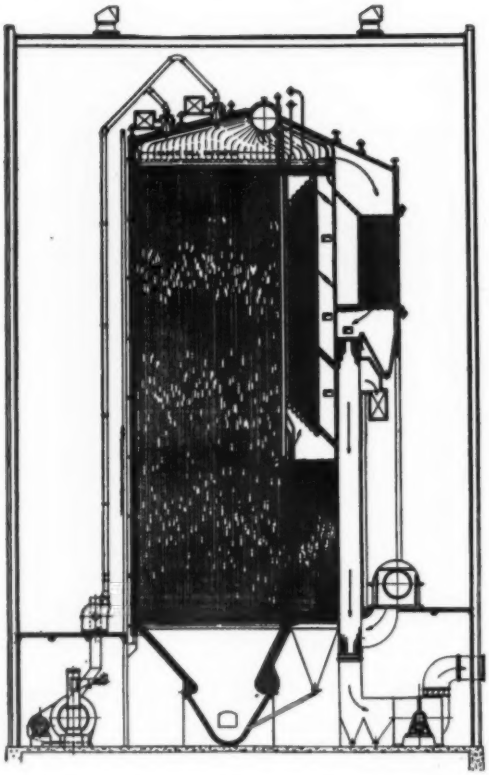
4 **YOU VISUALIZE SOLUTIONS** to your power distribution problems right on the top of your desk. At a glance, you see what space your proposed unit substation will occupy. You also see how it will look when actually installed in your plant.

5 **YOU DOUBLE CHECK** with A-C's Check List book which reduces every basic consideration in unit sub planning to its simplest possible form.

A 1828

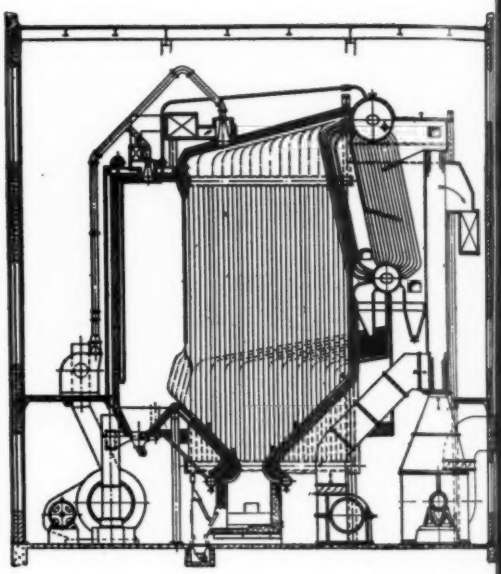
CHALMERS **"UNIT SUB BUILDER" SET**

STEAM GENERATORS



SINGLE DRUM RADIANT BOILER

Side walls and end tubes are made up from tubes set one against the other and outside of wall made up of heavy tile and heat absorbing material. The second row of tubes is made up of patented shadow walls connected with the same headers that receive the tubes already described. Heat passes from initial furnace up through superheater and then down through economizer, thence down through preheater. Superheat is controlled by dampers placed in space between superheater and outside wall. All tubes are connected to four headers, assuring simple installation.



BOILER WITH SEPARATE FIRED SUPERHEATER

This two-drum boiler is direct-connected to superheater a thereby restricting exhausted hot gases at the bottom. rate control of superheat at any steam flow is effect varying the heat output of the burner which fires into fu in which the superheater is located. Automatic regulati fuel and air to burner makes possible the maintenan uniform steam temperature over any load range or fluctuation. Close control of the entire unit is maintain all times.

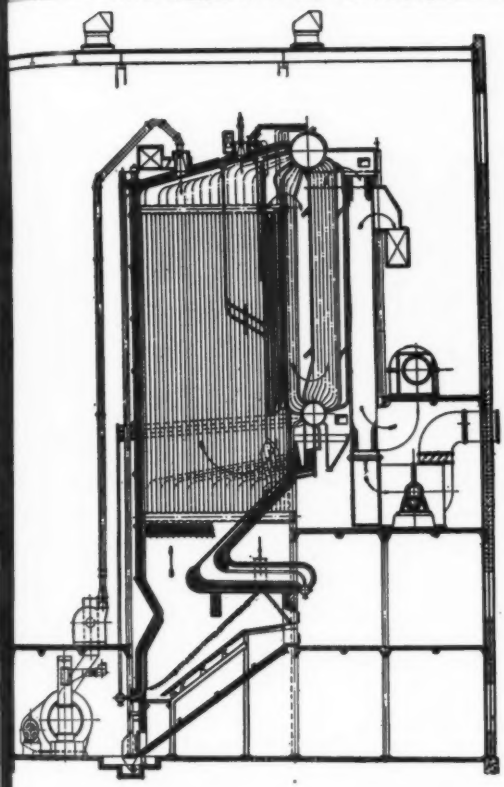
KVS BULLETIN 44

This 97-page, fully illustrated engineering bulletin is a handbook on modern steam generation practice. Kindly use your company letterhead in asking for your copy.

THE steam generators illustrated are typical examples of modern engineer practice as applied by KVS in boiler design. These units have been perfo ance-proved, provide for operation on either bituminous or anthracite coals can be depended on for high efficiency and low operating costs.

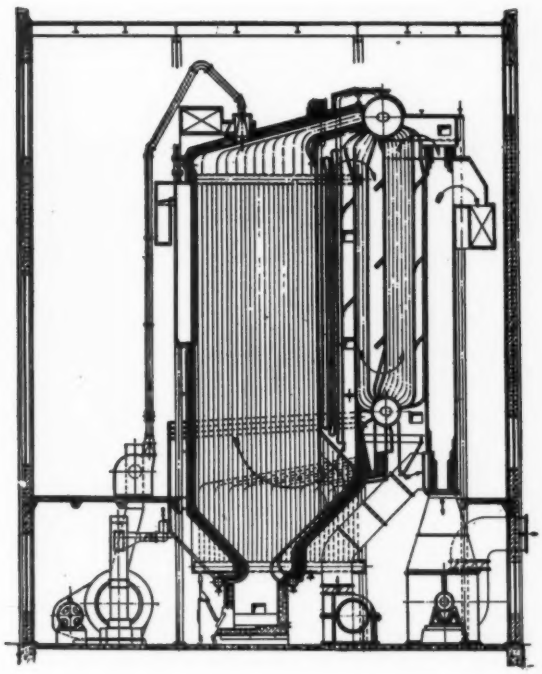
Designed, built and erected complete ready for operation by owner i capacity range from 30,000# steam and up, to any pressure and temperat specifications. KVS assistance on your requirements is available under a s responsibility.

...lesigned by KVS for efficient operation on a FULL RANGE of COALS



...ILER FOR TWO KINDS OF FUEL

...wo-drum boiler, with superheater and preheater, can be ... with anthracite or bituminous coal and any type coal ... when ground in the KVS Air Swept Tube Mill because ... perfect pulverization assured. A feature of this boiler ... it is designed to burn hog fuel—chips, bark, waste, etc. ... the lower grates. Both the pulverized coal firing and the ...uel firing are combined to operate either together or ...endently, as required, without interference one with the



CONVECTION BOILER FOR ALL FUELS

This KVS Steam Generator is designed especially for burning anthracite or low grade coal, thereby providing wide latitude in coal selection and making it possible to effect substantial savings in steam cost. Coal is fired at top and air passes down through furnace and then up through superheater. Superheater chamber is equipped with dampers for controlling superheat. Gas then goes through several passes in boiler and thence into top of preheater. Note that gas flow is streamlined from furnace entrance to stack.

Kennedy Products — KENNEDY-VAN SAUN — QUALITY SERVICE — NEW YORK USA — MFG. ENG. CORP.

Kennedy-Van Saun

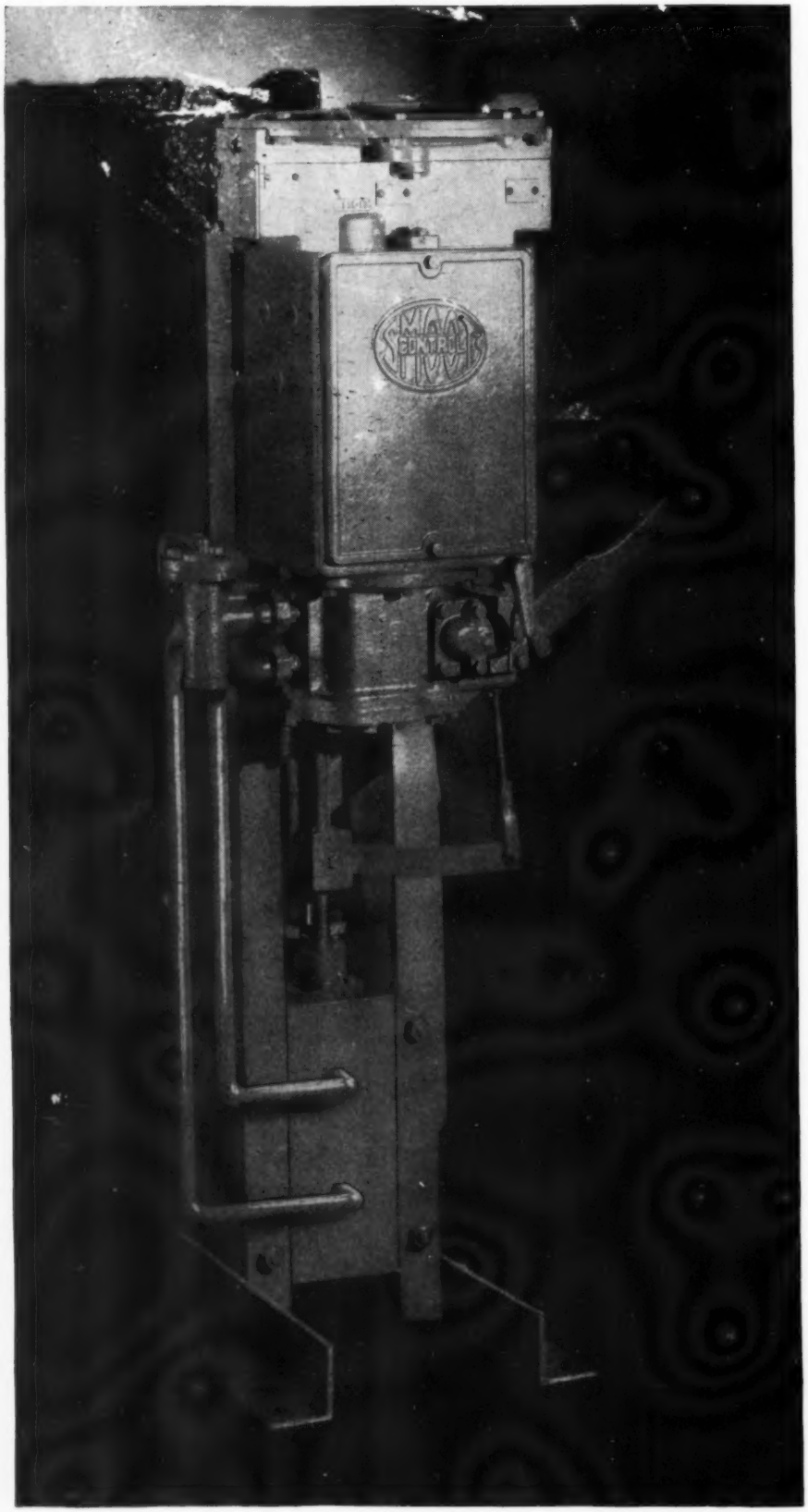
MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

The Trend is to...



REPUBLIC
REGULATOR APPLICATIONS

Pressure Control
Steam pressure control
Boiler furnace draft
Primary air pressure
Feed water pressure
Evaporator pressure
Process steam pressure
Blast air pressure
Exhauster suction
Fuel gas pressure
Suction main pressure
Excess pressure

Flow Control
Water flow to desuperheaters
Water flow to condensers
Oil flow to boilers and furnaces
Gas flow to boilers and furnaces
Air flow to gas producers
Pump bypass

Level Control
Hot well levels
Surge tank levels
Storage tank levels
Evaporator levels
Boiler water levels

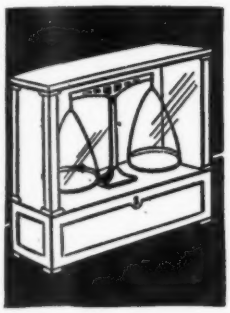
Speed Control
Stoker and fuel feeder speeds
Pulverizer speed
Pump speed
Fan speed
Steam turbine speed
Steam engine speed
Variable speed motors
Variable speed transmissions

View of a Republic hydraulic type regulator for controlling boiler air flow, mounted on stand with power cylinder.

REPUBLIC
INSTRUMENTS
AND CONTROLS

REPUBLIC Regulators

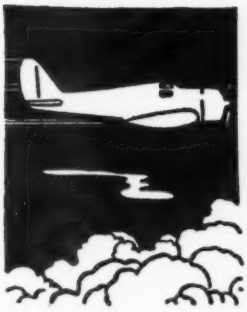
Because They Meet These Four Essentials of Good Regulation



Republic Regulators can be made sensitive to changes of less than 0.002 of an inch of water.

SENSITIVITY

The amount of change that is required in the quantity being controlled to effect the regulator is the measure of its sensitivity. For close, accurate regulation, a regulator must be sensitive. It must respond immediately to the slightest deviation from the predetermined setting or the controlled quantity may vary far beyond the permissible limits.



Republic Regulators will meet any speed requirement up to one full stroke in 2 seconds.

SPEED

The speed at which a regulator operates is an important factor in any control system. Any time lag between the variations in the controlled quantity and the operation of the control device to correct this variation, will produce an unnecessary error in regulation. A regulator, therefore, must be fast enough to follow the fastest load fluctuation.

Republic power cylinders are available to meet the specific power requirements of any particular installation.

POWER

A regulator must have sufficient power to not only operate the valve or other control device, but also to overcome any accidental friction or sticking that may occur in any part of the system. Insufficient power will cause failure in operation. It is for this reason that regulators are made with different size power cylinders, the smaller sizes being used for small valves and the larger sizes for the larger dampers and louvers.

The Republic stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

STABILITY

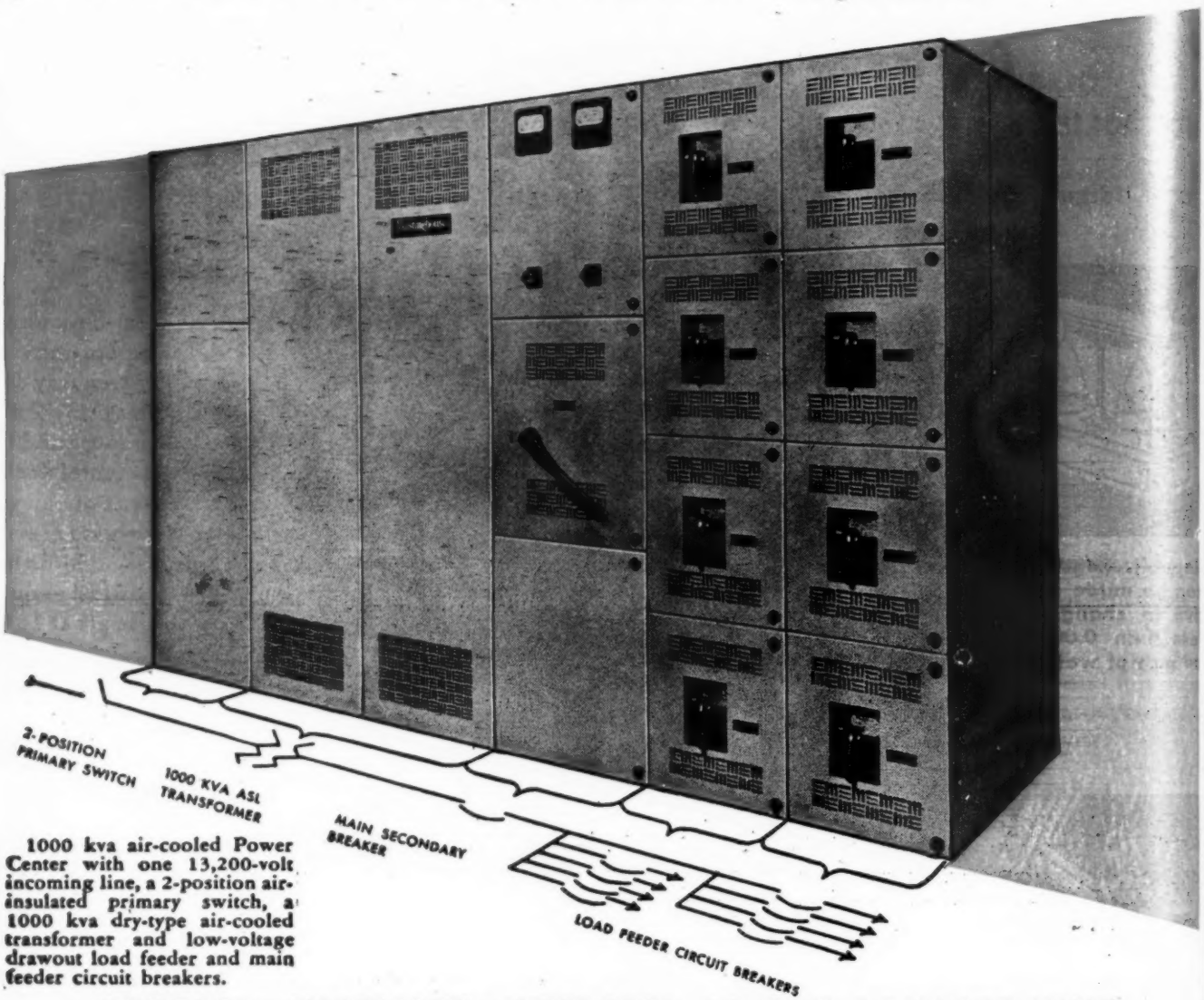
Stability refers to the ability of a regulator to maintain its balanced position or to return immediately to a balanced position if the controlled quantity is disturbed. There is always an interval between the time the valve or other control device is moved and the time the controlled quantity changes in response to this movement. Unless a regulator is stabilized it will tend to "hunt" or overtravel causing unnecessary variations.

Write for Data Book No. S-13

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

a new air-cooled unit power center for your electrical distribution system



1000 kva air-cooled Power Center with one 13,200-volt incoming line, a 2-position air-insulated primary switch, a 1000 kva dry-type air-cooled transformer and low-voltage drawout load feeder and main feeder circuit breakers.

ORDERED—INSTALLED—OPERATED AS ONE COMPACT UNIT

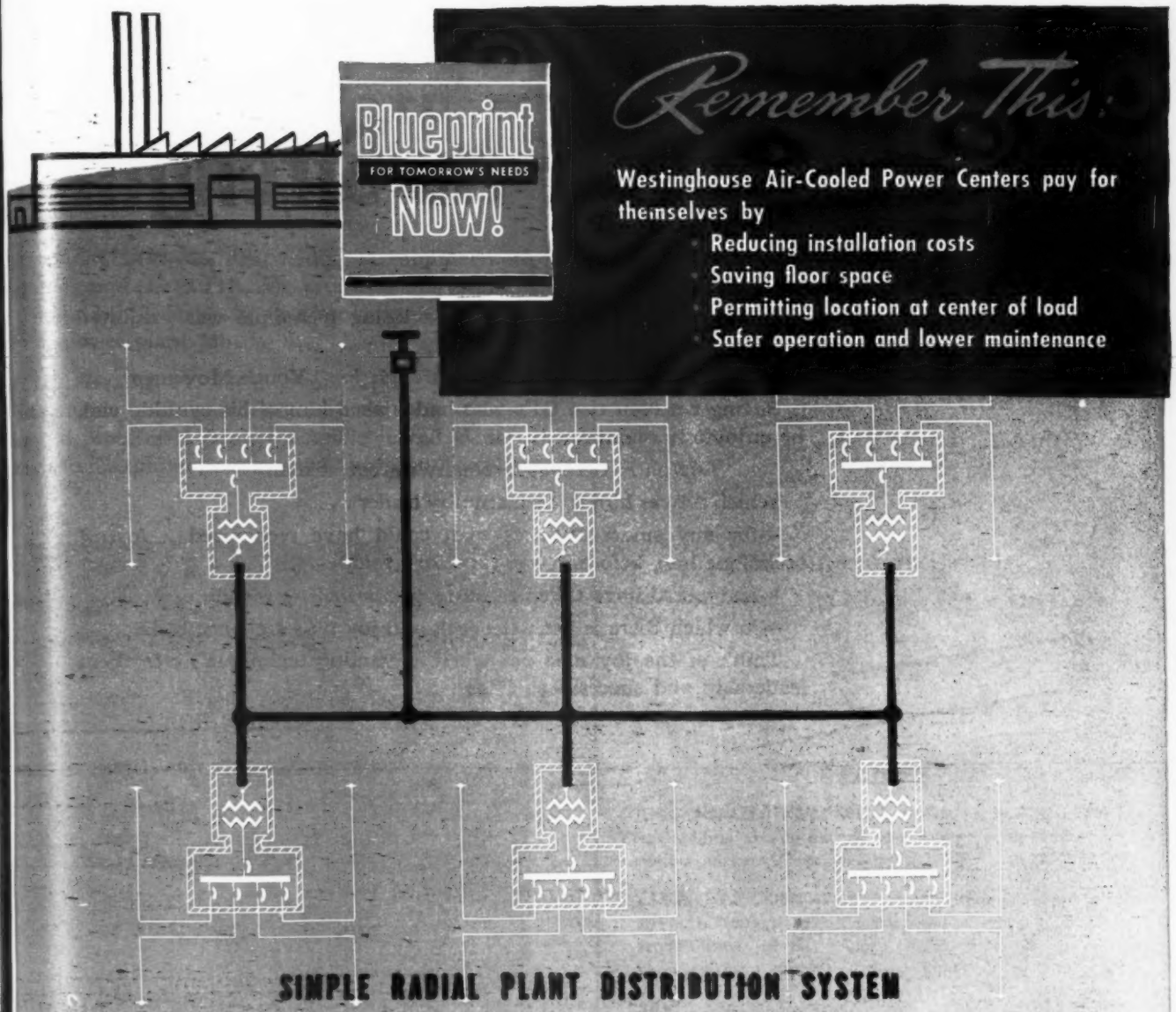
Here is a new heart for your plant's power distribution system—*the Westinghouse Close-Coupled Air-Cooled Power Center.* It saves time in ordering, installation and operation. It eliminates piecemeal assembly on the job! It can be installed anywhere indoors without a vault—because it is completely air-cooled. It can be installed in the immediate vicinity of working personnel with complete safety, or it can be placed overhead to save valuable floor space.

This completely metal-enclosed air-cooled Power Center results in substantial savings in materials and labor, and cuts down service interruptions, reducing your production losses. It permits location of the Power Center at or near the centers of load.

The Westinghouse Air-Cooled Power Center is only one item of the complete electrical equipment Westinghouse can supply. Others are: control centers, switches, breakers, capacitors, protective devices, switchgear—in fact, all the requirements needed for any industrial power distribution system. By ordering from *one* supplier, you place responsibility in *one* place . . . save time in ordering and installation and get co-ordinated operation.

Complete specifications on all equipment are available to help you PLAN NOW for postwar construction. Phone your Westinghouse Office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-94680



Remember This:

Westinghouse Air-Cooled Power Centers pay for themselves by

- Reducing installation costs
- Saving floor space
- Permitting location at center of load
- Safer operation and lower maintenance

SIMPLE RADIAL PLANT DISTRIBUTION SYSTEM

Since the first installation of Westinghouse Air-Cooled Power Centers, we have been receiving comments like these:

● **"Our air-cooled Power Centers, by removing the fire and explosion hazard, have paid for themselves in the elimination of the need for expensive fireproof vaults."**

● **"We like the unit construction, without throats, because it makes a much smaller and more compact Power Center. It saves us a lot of floor space."**

● **"The absence of insulating and cooling liquids permits us to locate the Power Center at the center of the load. This reduces the length of our feeders and saves copper."**

We sincerely believe that wherever good voltage regulation, high efficiency and safety are "musts", the Westinghouse Air-Cooled Power Center is best suited for tomorrow's profitable production of peacetime goods.

Westinghouse also supplies equipment for all types of electrical distribution systems, and will recommend the one system best suited to your requirements.

Call your Westinghouse representative today for advice and *practical* help in laying out your postwar industrial power distribution and control systems. It pays to *blueprint now for tomorrow's needs.*

Westinghouse
PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

AIR-COOLED POWER CENTERS

Then he said to himself

"No Joy—No Strength"

HIGH point in faith toward a losing technique was exhibited by "Herr Doktor" Ley . . .

—leader of Hitler's "Strength Through Joy" Youth Movement.

Sitting between two GI's who had frisked him of his cyanide vial, he unjoyfully maintained:

"Adolph Hitler was Germany's greatest man."

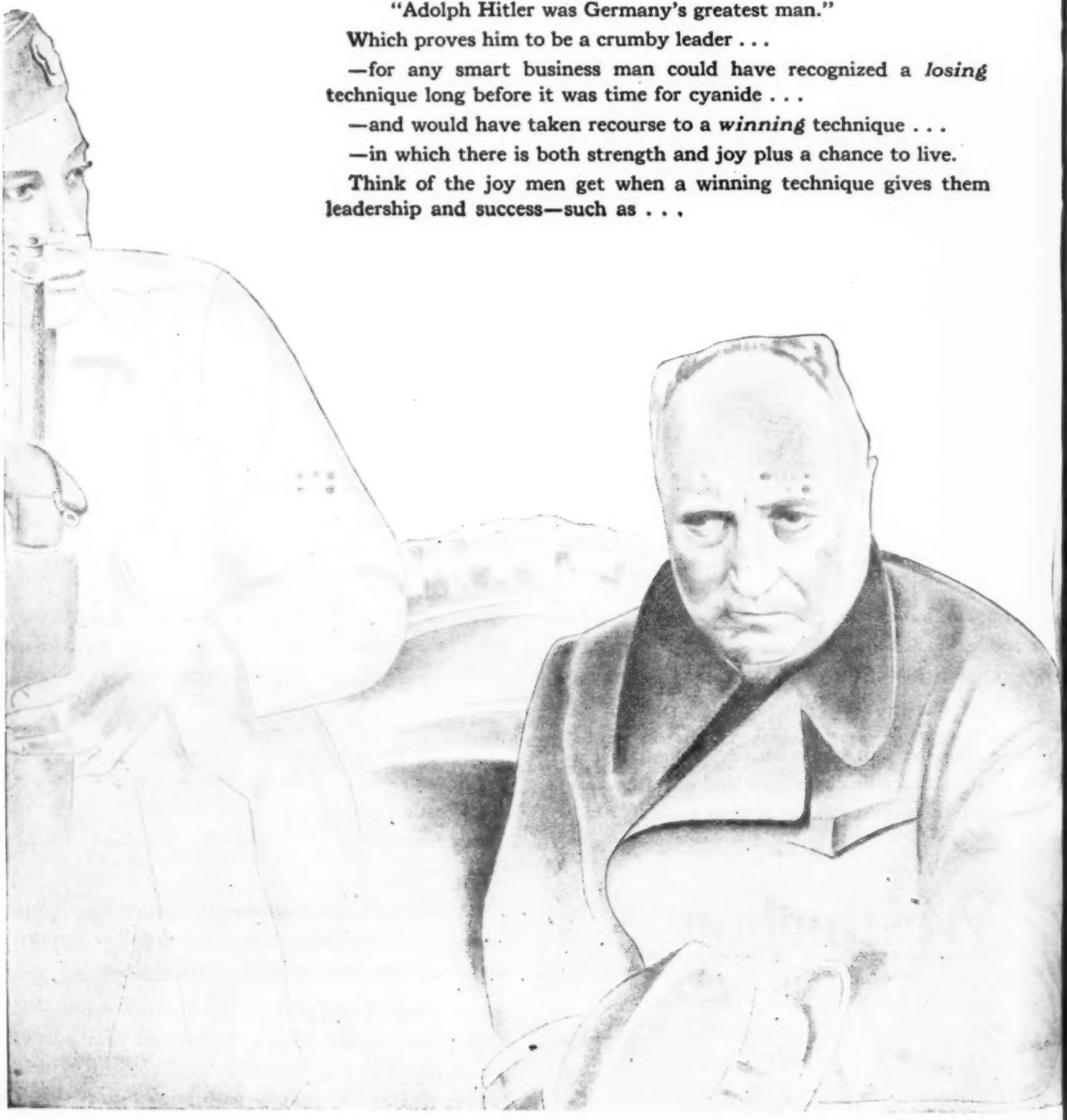
Which proves him to be a crumby leader . . .

—for any smart business man could have recognized a *losing* technique long before it was time for cyanide . . .

—and would have taken recourse to a *winning* technique . . .

—in which there is both strength and joy plus a chance to live.

Think of the joy men get when a winning technique gives them leadership and success—such as . . .



LOOK, HERR DOKTOR, how to obtain

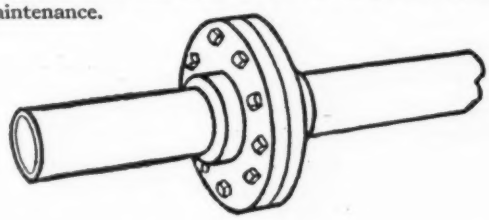
STRENGTH THROUGH ARC WELDING

STRONG ON SAVINGS. Arc welding streamlines both the piping and the installation procedure. Saved 30% in time and 20% in costs over conventional method for this power plant job.

STRONG PHYSICALLY. Welding produces a joint that is permanently leak-proof and as strong as or stronger than the pipe itself. Makes possible installations to withstand maximum pressure and maximum temperature.

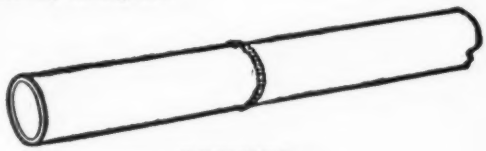
FORMER TECHNIQUE

Cut and thread ends of pipe . . . Assemble with 2 flanges, gasket and set of bolts . . . Joint requires maintenance.



THE WINNING TECHNIQUE

Arc Weld Bevelled-end pipe . . . Joint is strong, permanently leak-proof.



RESULTS:

CUTS INSTALLATION TIME. Arc Welding avoids delays in detailing, fitting extra parts, applying supports, inserting gaskets. Cuts time up to 50%.

SAVES PIPE COST. Welded construction develops full strength throughout, permitting use of lighter pipe. By streamlining joints, reduces friction, increasing pipe capacity often permitting use of smaller pipe.

SAVES SPACE. Because of streamlined exterior and easy access, permits installation in tight corners.

SIMPLIFIES INSULATION. Arc Welded piping, devoid of projections, is easy to insulate and paint.

IMPROVES APPEARANCE. Joint surfaces of Arc Welded piping are as smooth as the pipe itself.

Lincoln Engineers will gladly help apply this winning technique to the solution of *your* piping problems.

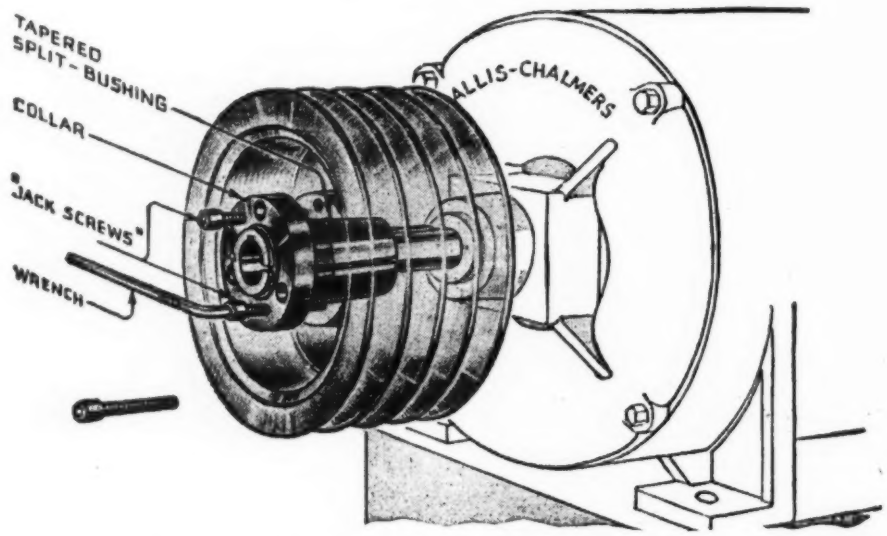
THE LINCOLN ELECTRIC COMPANY • Dept. E-2 • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

X-Ray View

OF ALLIS-CHALMERS' NEW "MAGIC-GRIP" SHEAVE



Fastest mounting and demounting sheave on the market, the new "Magic-Grip" costs you nothing extra.

1 **Remove three capscrews** from bushing collar. A handy wrench — supplied with each sheave — is the only tool needed to remove Allis-Chalmers' new "Magic-Grip" from motor or machine shaft quickly and easily.

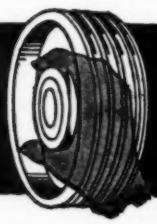
2 **Insert two capscrews** in tapped holes. As screws are turned, they become levers . . . automatically breaking tight grip of tapered split bushing on sheave and shaft. Entire unit is then ready for removal.

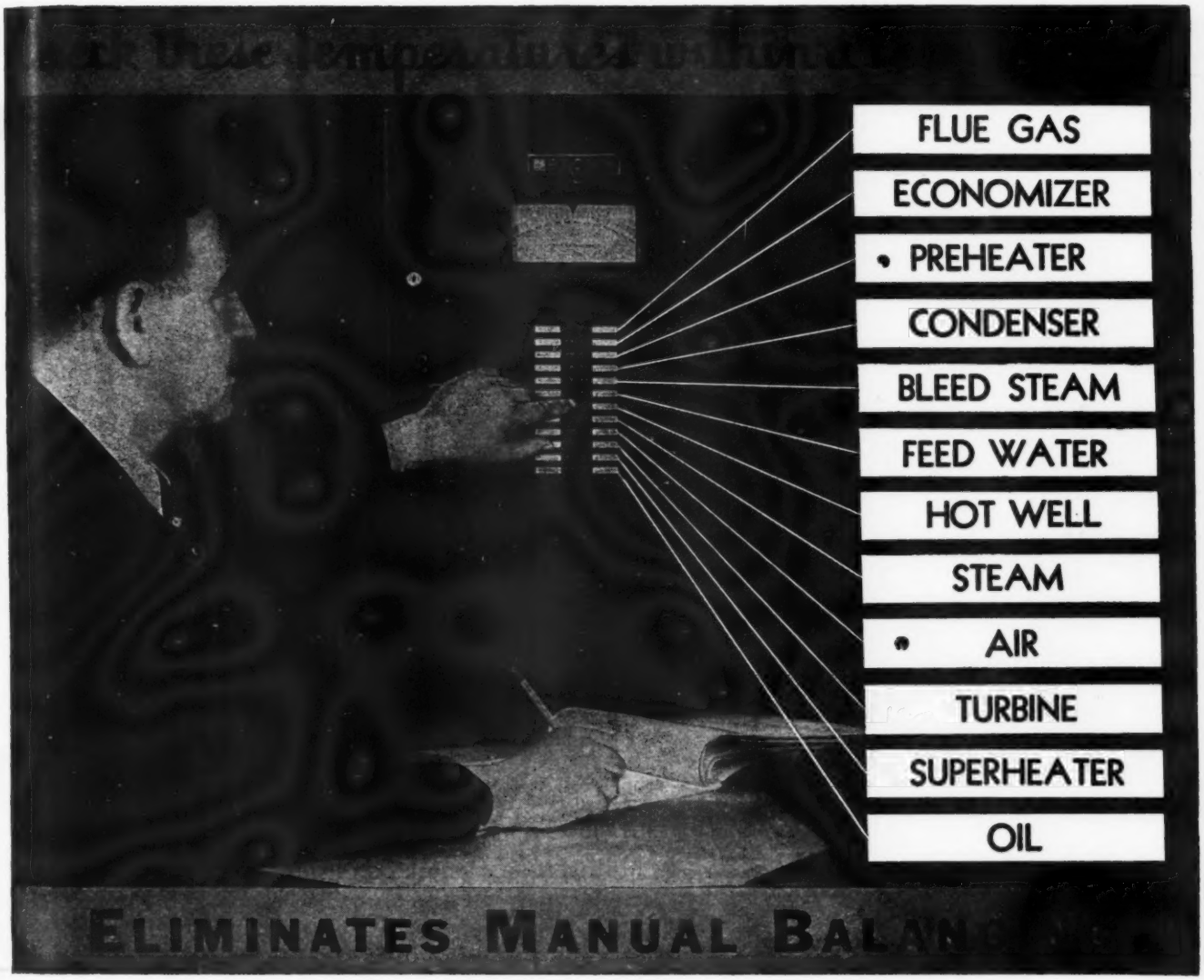
3 **Remove sheave from shaft.** Requires no mallet, no prying, no bulging muscles. You just slide the sheave off . . . smoothly, quickly. *It costs nothing extra!* Send for B6310 Allis-Chalmers, Milwaukee 1, Wis.

A 177

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES





The self-balancing Centralized Reading Indicator pictured above is as modern as jet propulsion.

The operator merely touches the desired switch. The instrument does the rest, leaving his hands free to log readings.

Time required between readings is limited *ONLY* by human ability to pick off a reading. Compare this time to that required to read an outmoded *manual* balance indicator, designed when shaving mugs were on every barber shop shelf.

The Brown Centralized Reading Indicator is unique for other reasons too.

The electronic "Continuous Balance" principle delivers sensitivity previously unheard of. Imagine being able to read one part in twenty-four hundred!

The ElectroniK is totally unaffected by vibration —mount it on a pulverizer frame if it suits your purpose.

The ElectroniK utilizes circular instead of reciprocating motion. Components move only when the scale is changing position.

Specify the Brown Precision Indicator for that post-war boiler.

Specify it too, for your present station. Utilizing the same wiring and thermocouples, it readily replaces old-fashioned instrumentation.

Write for Bulletin 15-4, THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Co., 4490 Wayne Avenue, Philadelphia 44, Pa. Branches in all principal cities. 119 Peter St., Toronto, Canada; Wadsworth Road, Perivale, Middlesex, England; Nybrokajen 7, Stockholm, Sweden.

BROWN *Electronik* POTENTIOMETERS

Interchangeable

MEAN EASIER, LOWER COST VALVE

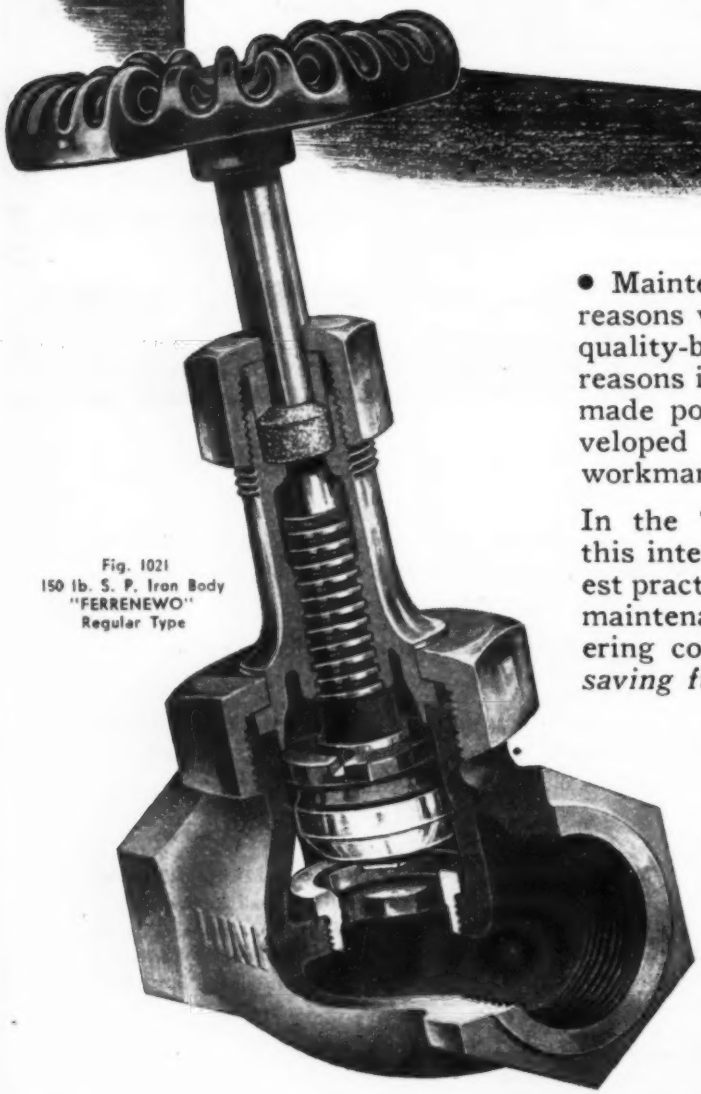


Fig. 1021
150 lb. S. P. Iron Body
"FERRENEWO"
Regular Type

• Maintenance men can give you a flock of reasons why they prefer LUNKENHEIMER quality-built Valves. Prominent among those reasons is the *wide* interchangeability of parts made possible by Lunkenheimer's highly developed simplicity of design and precision workmanship.

In the "Renewo" and "Ferrenewo" Valves, this interchangeability has long been of highest practical value to industry, in making valve maintenance easier, speeding production, lowering costs. And—vitally important today—*saving fuel* that comes from tight valves.

Correct design, accurate machining, careful testing—these are basic essentials of the extra long service life and maintenance economy for which Lunkenheimer Valves are famous.

The Lunkenheimer Co., Cincinnati 14, Ohio, U. S. A. Branch Offices: New York 13, Chicago 6, Boston 10, Philadelphia 7. Export Department: 318-322 Hudson St., New York 13, N.Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

Parts MAINTENANCE

Fig. 73-P
200 lb. S. P. Bronze
"RENEWO"
Plug Type

Fig. 73
200 lb. S. P. Bronze
"RENEWO"
Regular Type

HERE'S HOW IT WORKS!

All parts of the valves shown (except bodies and bonnet rings) fit each other perfectly. If, for example, you need a stem, disc, or seat ring for the "Renewo", you can use the corresponding part of the "Ferrenewo"—*it is exactly the same.* This means fewer parts to be carried, speedier repairs, and greater ease in making them.

Lunkenheimer Distributors are located in the principal industrial centers. There is one near you. Call on him—you'll find him equipped with a complete stock of parts that will make Lunkenheimer "interchangeability" a time-saving, labor-saving, money-saving FACT in your plant!

LUNKENHEIMER VALVES

The new boiler brought new problems

....but HALL ENGINEERS had the *Answers*

THE CHANGE from 125-lb. boilers to a 600-lb. boiler brought varied problems to a major leather manufacturing plant.

Raw water supply was one of these, for the available water was contaminated and highly variable. This water was treated in a cold process softener employing various coagulants, including magnesium sulphate, then—still highly variable—went to a hot process softener for final softening. No filters were used.

Condensate returns were badly contaminated particularly with oil, and had to be treated with a coagulating agent, coagulated and filtered.

The boiler was customarily run at ratings over its capacity.

Here's what Hall engineers did:

1. Set up a schedule for the hot process softener, which, in spite of the variable character of input water, kept hardness and suspended matter low in the effluent water.

2. Planned the installation of an adequate oil removal system for the condensate, and recommended suitable coagulating chemical.

3. Taught the operating force to appreciate the need for exact and continuous control of conditions.

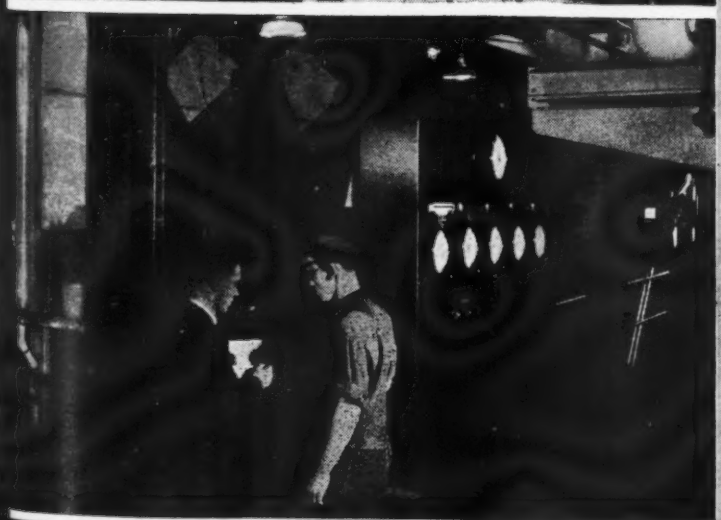
The boiler was opened and turbined shortly after these measures were put into effect. A year later, after eight months of use and four months stand-by, it was again opened and found to be in excellent condition. Main generating tubes were clean, and no signs of carryover were noted in the superheater tubes. An inconsequential amount of semi-hard deposit was found in the water wall tubes.

This was the longest time this particular boiler had ever operated without difficulty due to water.

Every plant generating its own steam can profitably use Hall service. Write us for full information.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
CALGON



Here's what

HALL CLIENTS GET:

1. Thorough study of all factors concerning water involved in producing steam.
2. Procedure for the proper treatment of boiler water.
3. Instruction of designated employees in making of essential control tests.
4. Periodic check up by Hall service engineers.
5. Periodic checking of samples by Hall Laboratories.
6. "Trouble shooting" that includes all service necessary as problems arise.

...all of which adds up to *boilers that stay on the line!*

HALL SYSTEM *of Boiler Water Conditioning*

PIPE-LINE EXPRESS!

A pipe line, stretching for a thousand miles. Inside, a column of oil that must keep moving. Pumping stations from point to point. ALCO Diesel Engines, to drive the pumps, meet this vital need for supremely dependable power.

Through pipe lines, ALCO Diesel Engines pump rivers of petroleum and petroleum products to refineries and ports.

ALCO Diesel Engines are light-weight, heavy-duty, compact power units built for every job where quick, adequate, dependable power is needed. ALCO pioneered this new, better type of Diesel Engine. More than 1,500,000 horse-

power of ALCO Diesel Engines are in service for innumerable applications—marine, stationary and mobile.

All we can build are now needed for war work. But soon, we hope, ALCO Diesel Engines, including new important features, will be available to give *you* quick power, efficient power, with maximum space economy and minimum unit weight.

American Locomotive

ALCO DIESEL ENGINES

for Universal Application

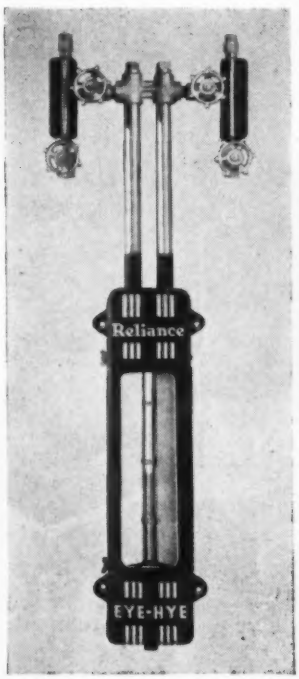
30 Church Street, New York 8, N. Y.

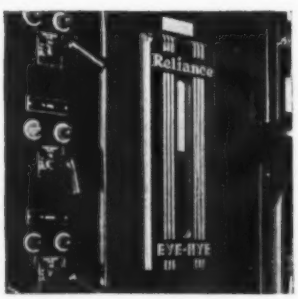
EYE-HYE rewards you with *step-saving efficiency and safety*

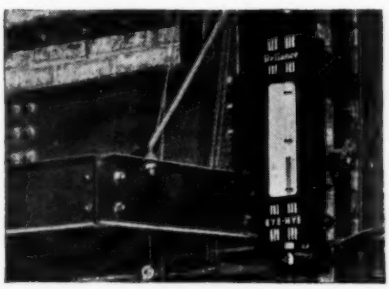
Gives you handy eye-level reading for all water level gaging needs

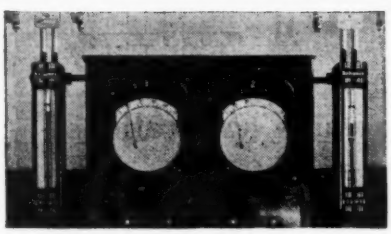
THE convenience of reading your boiler water levels in the EYE-HYE, alongside other instruments, works wonders in boiler operating efficiency. You can make more *frequent* checks more *easily*—and the closer the supervision the less likely you are to let dangerous low or high water level conditions develop. ● EYE-HYE's easily understood simplicity and sturdy, dependable construction guarantees constant accuracy. It's good practice to use EYE-HYE also for power plant vessels other than boilers—such as feed water heater tanks, storage tanks, surge tanks, etc. There are models correctly designed for all working steam pressures and to serve various water level variations. The EYE-HYEs you place on capacity tanks can be marked with convenient graduated scales.

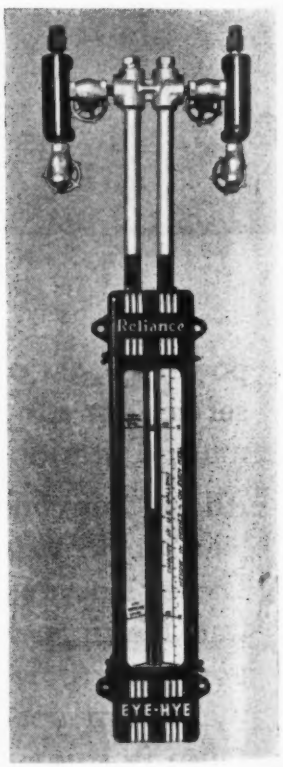
EYE-HYE deliveries are improving and orders are now being accepted without priority ratings. It will pay you to check your remote indication needs and plan to increase the efficiency and safety of your power plant. Write for Bulletin 382-C.











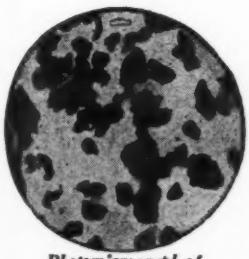
BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. 5902 CARNEGIE AVENUE · CLEVELAND 3, OHIO

BAYOU WATER CONDITIONED BY COCHRANE CARBONACEOUS ZEOLITE SOFTENER

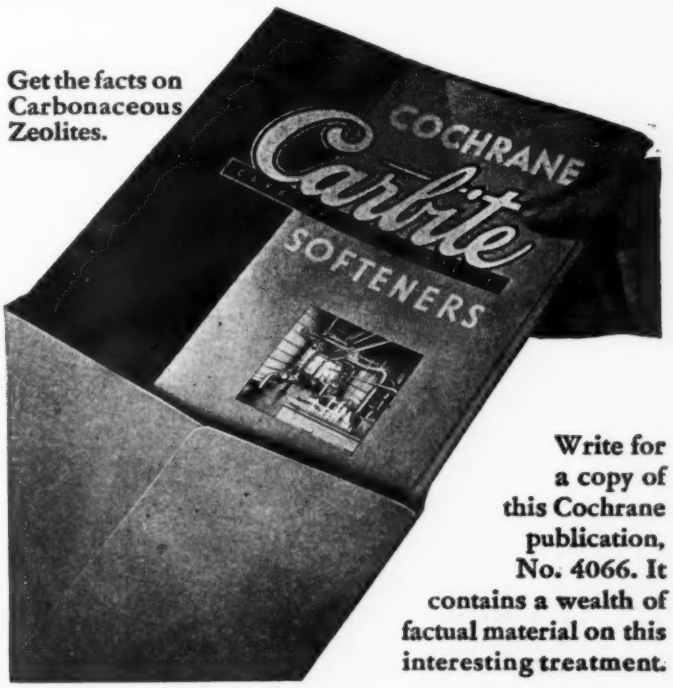
Southern plant makes use of new type of zeolite for softening feedwater after clarification and filtering by means of other Cochrane apparatus



Photomicrograph of Cochrane Carbite

THE only water available for boiler use at a newly-erected plant in the South is from a neighboring bayou. This water is highly colored, but contains little suspended matter. It is clarified with aluminum sulphate, using a Cochrane displacement type Chemical Feeder, after which it is filtered through Cochrane Filters. It is then softened in 4 Cochrane Carbonaceous Zeolite Softeners and the alkalinity reduced by the use of sulphuric acid, proportioned by a Cochrane double displacement acid-feeding equipment. It is next deaerated in a 400,000 lb./hr. Cochrane Deaerator and delivered to the boiler after receiving a supplementary phosphate treatment.

Get the facts on Carbonaceous Zeolites.



Write for a copy of this Cochrane publication, No. 4066. It contains a wealth of factual material on this interesting treatment.

COCHRANE CORPORATION
A DIVISION OF AMERICAN ENGINEERING COMPANY

ARMY E NAVY

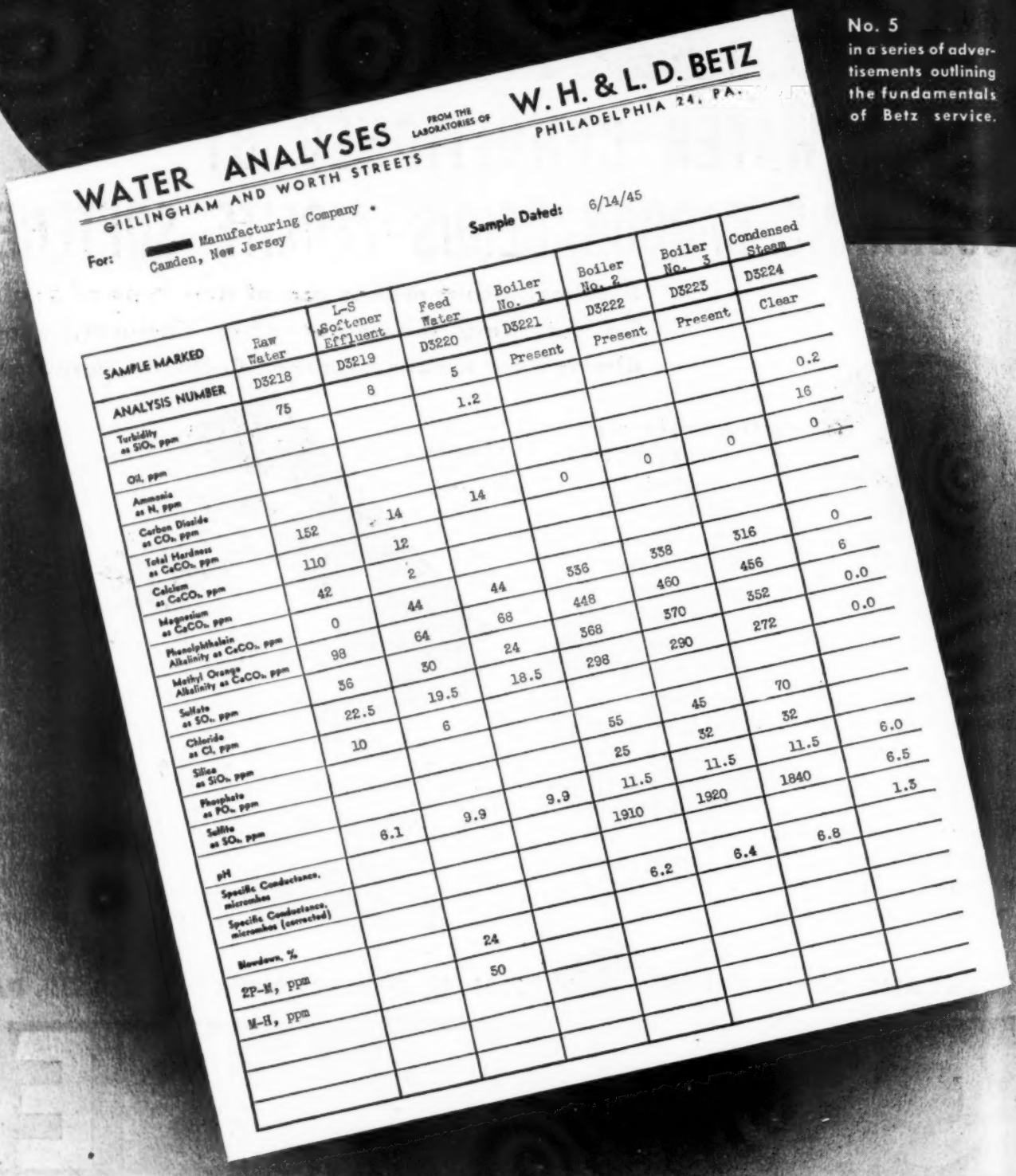
3106 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

HOW BETZ
double checks plant control tests

No. 5
in a series of advertisements outlining the fundamentals of Betz service.



WATER ANALYSES FROM THE LABORATORIES OF W. H. & L. D. BETZ
GILLINGHAM AND WORTH STREETS PHILADELPHIA 24, PA.

For: [redacted] Manufacturing Company • Sample Dated: 6/14/45
Camden, New Jersey

SAMPLE MARKED	Raw Water	L-S Softener Effluent	Feed Water	Boiler No. 1	Boiler No. 2	Boiler No. 3	Condensed Steam
ANALYSIS NUMBER	D3218	D3219	D3220	D3221	D3222	D3223	D3224
Turbidity as SiO_2, ppm	75	8	5	Present	Present	Present	Clear
Oil, ppm			1.2				0.2
Ammonia as N, ppm							16
Carbon Dioxide as CO_2, ppm						0	0
Total Hardness as $CaCO_3$, ppm	152	14	14	0	0		
Calcium as $CaCO_3$, ppm	110	12					0
Magnesium as $CaCO_3$, ppm	42	2					
Phenolphthalein Alkalinity as $CaCO_3$, ppm	0	44	44	336	338	316	6
Methyl Orange Alkalinity as $CaCO_3$, ppm	98	64	68	448	460	456	0.0
Sulfate as SO_4, ppm	36	30	24	368	370	352	0.0
Chloride as Cl, ppm	22.5	19.5	18.5	298	290	272	
Silica as SiO_2, ppm	10	6					
Phosphate as PO_4, ppm				55	45	70	
Sulfite as SO_3, ppm				25	32	32	
pH	6.1	9.9	9.9	11.5	11.5	11.5	6.0
Specific Conductance, micrombos				1910	1920	1840	6.5
Specific Conductance, micrombos (corrected)							1.3
Blowdown, %			24		6.2	6.4	6.8
2P-M, ppm			50				
M-R, ppm							

● Betz supervisory boiler water control service leaves nothing to chance. There are no mere guesses or assumptions that conditions are satisfactory at the plant. Thus, in addition to regular personal visits by Betz engineers and daily testing by the boiler plant operators, we also "double-check" by means of more complete analyses in our own laboratories.

At regular intervals, water samples from all important points throughout the system are secured by our engineers and forwarded to our headquarter laboratories. Here, trained chemists conduct careful and complete analyses on each sample. A report, as shown on the opposite page, is then submitted to the plant. In many cases these "check analyses" reveal conditions which may not be evident from plant control tests. Such complete laboratory analyses enable our Engineering Department to make corrective recommendations *well in advance*, thereby heading off any serious trouble which might otherwise develop.

This added feature of Betz supervision is a service that can be extended only by an organization equipped with modern laboratory facilities. At our headquarter laboratories in Philadelphia we conduct over 45,000 "check analyses" each year. This is an essential part of a service which assures our clients a complete protection against unscheduled boiler outages.

W. H. & L. D. BETZ

Gillingham & Worth Sts., Philadelphia 24, Pennsylvania

THE 6 FUNDAMENTALS OF BETZ BOILER WATER CONDITIONING SERVICE

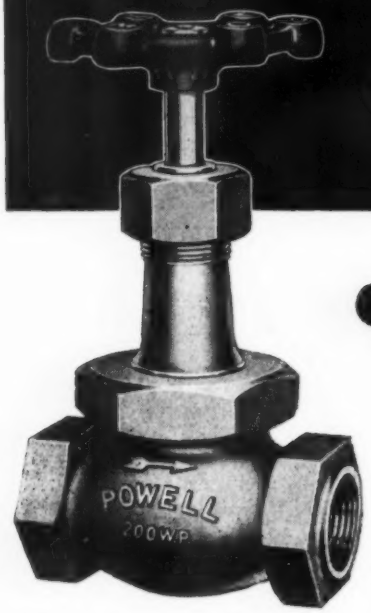
1. Complete plant investigation and report.
2. Establishment of plant control.
3. Daily plant control tests.
4. Detailed review of plant tests and report.
5. **Supplementary complete laboratory analyses.**
6. Periodic "check-up" visits.

CHEMICAL ENGINEERS—
CONSULTANTS ON ALL WATER PROBLEMS

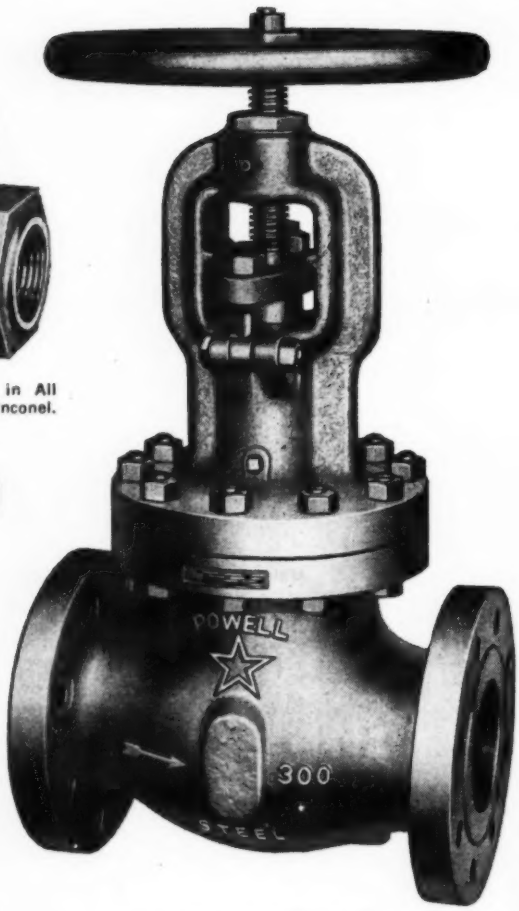
BETZ

PURE NICKEL
MONEL METAL *
INCONEL *
VALVES

*These names are registered trade-names of the International Nickel Company, Incorporated.

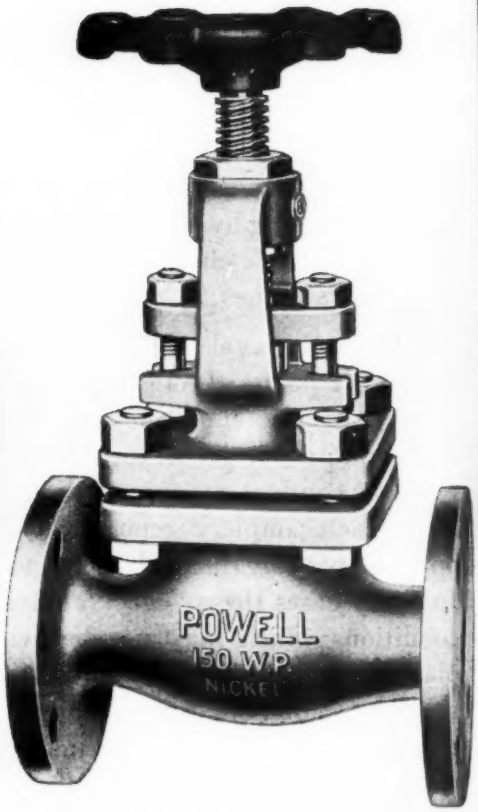


200-pound Globe Valve. Available in All Pure Nickel, All Monel Metal or All Inconel.



Class 300-pound Cast Steel Globe Valve with Monel Metal trim.

200-pound Gate Valve. Available in All Pure Nickel, All Monel Metal or All Inconel.



150-pound O. S. & Y. Gate Valve. Available in All Pure Nickel, and All Monel Metal or All Inconel.

POWELL

The Solution to many a flow control problem

Class 300-pound Cast Steel Gate Valve with Monel Metal trim.

All-Pure-Nickel, all-Monel Metal and all-Inconel Valves as well as valves with Monel-Metal trim (internal working parts) are another outstanding Powell contribution to help solve Industry's flow control problems! In all services where corrosion and excessive heat or cold are encountered; where absolute purity of the end product must be maintained; and for the handling of steam, water, acid, alkalies and many other media these valves are superior to all others. This has been conclusively proved by performance records in leading plants throughout the nation.

For twenty years, Powell Engineers and the Powell Special Alloy Valve Division have designed and fabricated valves in a wide variety of pure metals and special alloys to meet every flow control requirement of Modern Power, Chemical, Food Processing and Textile Plants, Oil Refineries, etc. This specialization is your assurance of satisfaction. Write NOW for details and your copy of our new booklet "Powell Valves for Corrosion Resistance."

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Dependable Valves since 1846

Cincinnati 22, Ohio

DISTRIBUTORS AND STOCK IN PRINCIPAL CITIES

VALVES

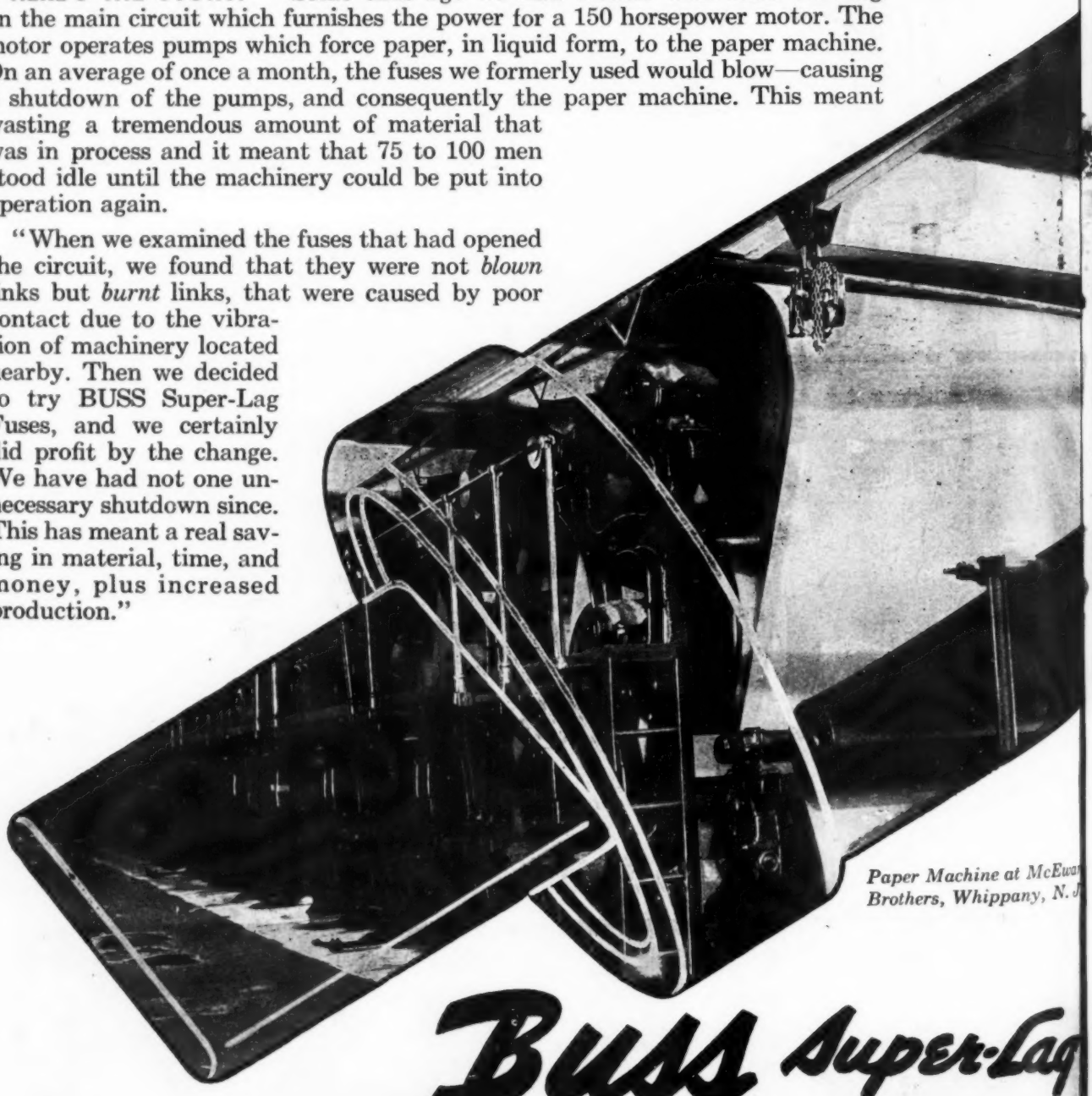
"75 to 100 Men Were Thrown Out of Work Every Time we had an Electrical Shutdown—then . .

We Discovered BUSS Fuses Would Cure Our Troubles"

. . . Mike Verder, Chief Electrician, McEwan Brothers, Whippany, New Jersey

HERE'S THE STORY:—"Some time ago we had trouble with fuses blowing on the main circuit which furnishes the power for a 150 horsepower motor. The motor operates pumps which force paper, in liquid form, to the paper machine. On an average of once a month, the fuses we formerly used would blow—causing a shutdown of the pumps, and consequently the paper machine. This meant wasting a tremendous amount of material that was in process and it meant that 75 to 100 men stood idle until the machinery could be put into operation again.

"When we examined the fuses that had opened the circuit, we found that they were not *blown* links but *burnt* links, that were caused by poor contact due to the vibration of machinery located nearby. Then we decided to try BUSS Super-Lag Fuses, and we certainly did profit by the change. We have had not one unnecessary shutdown since. This has meant a real saving in material, time, and money, plus increased production."



Paper Machine at McEwan Brothers, Whippany, N. J.

BUSS Super-Lag

Mr. Mike Verder, Chief Electrician, McEwan Brothers, Whippany, N. J.

Here is why BUSS fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating which causes fuses to blow needlessly is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of Shutdowns caused by needless fuse blows.

And Here Is How to Solve the "Shutdown Problem" in Your Plant

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection of BUSS Super-Lag fuses.

BUSSMANN MANUFACTURING CO.
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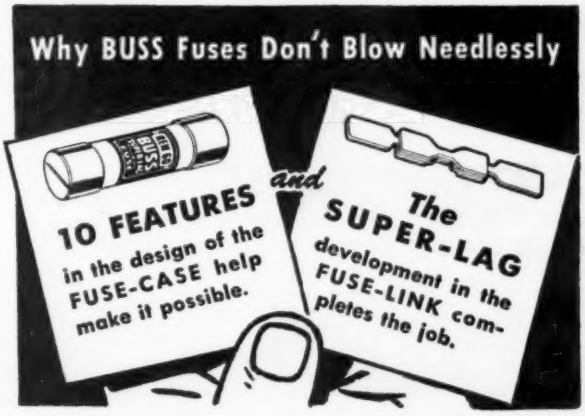

Why BUSS Fuses Don't Blow Needlessly
10 FEATURES
in the design of the FUSE-CASE help make it possible.
and
The SUPER-LAG
development in the FUSE-LINK completes the job.

Fuses

SOLD THROUGH WHOLESALERS

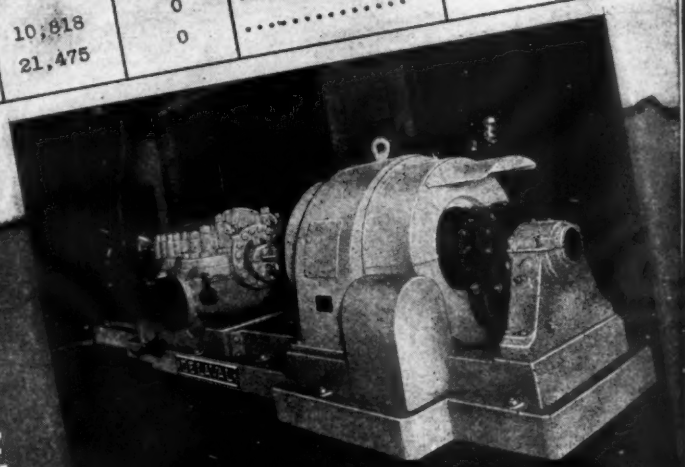
Look at the Record!

SERVICE RECORD—As of September 1, 1944

DE LAVAL PUMPS at ———

No.	Discharge Pressure psig	Suction Temp. °F.	Placed in Service	Total Service Hours	Outages Due to Pump	Cause of Outages	Approx. % Increase in Pump Power
14	1186	260°	12- 2-38	40,383	2	Replace ball locating bearing and shaft sleeves	Negligible
15	1186	260°	10-11-40	28,839	1	Replace shaft sleeves	Negligible
21	1186	350°	8- 4-39	10,818	0	.....	Negligible
16	1186	260°	1- 2-42	21,475	0	.....	5%

Capacity (all units).....1455 g.p.m.



of DE LAVAL HIGH-PRESSURE BOILER-FEED PUMP PERFORMANCE

Not one major trouble after as much as 40,000 hours of service!

The first of these units was installed in February, 1938; the most recent in February, 1942. All have demonstrated the satisfactory performance of De Laval boiler-feed pumps for high-pressure central station service.

Other important installations, operating at pressures up to 1600 psi and handling high temperature feed water, are operating with equal freedom from trouble, due in no small measure to the excellent performance of the De Laval automatic balancing device, the De Laval large clearance labyrinth wearing rings, and the sturdiness of De Laval solid end head construction.

3629

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY - TRENTON 2, NEW JERSEY

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A McGRAW-HILL PUBLICATION

N O WYNKOOP, *Publisher* P W SWAIN, *Editor*

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SEPTEMBER, 1945 VOLUME 89, NUMBER 9

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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watch

THE LINK-GRATE ACTION AND YOU'LL SEE

THE LINK-GRATE ADDS UP TO THESE 10 ADVANTAGES

- Permits use of low-cost fuel
- Effectively handles all types of loads
- Assures accurate control of air flow
- Fuel bed flow is unrestricted
- Prevents formation of objectionable clinkers
- Ash discharge is continuous
- Provides high reserve capacity
- Keeps operating costs low
- Simplifies control
- Keeps installation cost low

Thorough combustion. No troublesome clinkers. No periodic dumping of ashes. Operating costs held down. All these advantages because the Link-Grate keeps the fuel bed porous and lets low pressure air flow through the grates.

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

WESTINGHOUSE STOKERS

WHY GIVE MORE STEAM PER POUND OF COAL

Combustion is thorough with a Link-Grate Stoker. The right amount of coal, the right amount of air, are brought together at exactly the right time. There is little unburned fuel in the ash discharge. You get more steam per pound of coal.

The Link-Grate motion maintains a regular combustion rate by continuously processing the fuel bed to keep it porous. Agitation at the rear of the stoker promotes a uniform flow of coal over the underfeed section and keeps the burning lanes open.

Grates first move up to break open the fuel bed and let low pressure air flow through the grates. The downward movement of the grates crumbles and conveys the burning fuel.

Positive movement of the fuel bed toward the continuous ash discharge eliminates periodic dumping and reduces servicing. Clinkers are no problem. Link-Grate motion prevents closed pores in the fuel bed and eliminates the cause of large clinkers.

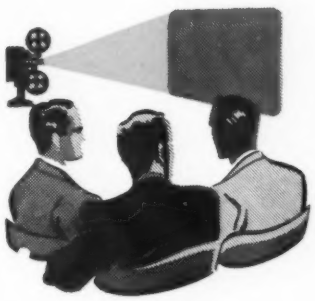
Ability to handle all types of loads is another outstanding characteristic of the Link-Grate Stoker. It can meet suddenly increased steam demands quickly with full combustion efficiency because the fuel bed is always porous.

Before you make another investment in stokers be sure you have complete information about the Link-Grate. If possible, see one in operation. Your nearest Westinghouse office will be glad to arrange an appointment with a present user. Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

J-50465

SEE A LINK-GRATE DEMONSTRATION IN YOUR OWN OFFICE

Almost invariably, when a stoker buyer sees a Link-Grate in action, he becomes a user. Realizing the difficulty that is often encountered by an individual or group in visiting a stoker installation, Westinghouse has prepared a new 15-minute 16 mm sound movie showing in detail the operation of a Link-Grate Stoker. Prints of this picture are available on loan for your private showing. Just address your request to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.



WESTINGHOUSE

Link-Grate STOKERS

This "RADIAL" WATER WELL safeguards flow and purity with BYERS WROUGHT IRON SCREEN PIPE

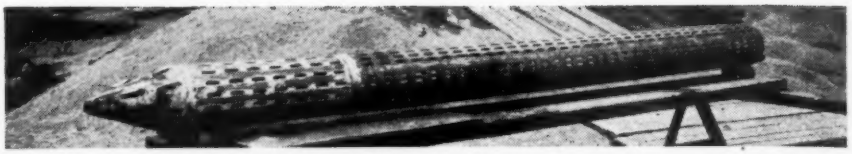
This well at an Ohio industrial plant is unusual in that it is literally "drilled sideways." But it conforms to old established engineering practice in the choice of materials, for Byers Wrought Iron was selected for the screen pipes which radiate from the central shaft.

Durability and dependability is of prime importance in both strainer pipe and casing, as corrosion from both soil and water may be severe. Byers Wrought Iron has been used so much and so long that almost every community can provide a testimonial to its superior performance. In an Illinois well, wrought iron casing pulled after 52 years service was still in excellent condition. A Wisconsin installation gave 43 years service without a single leak. These are just two of many.

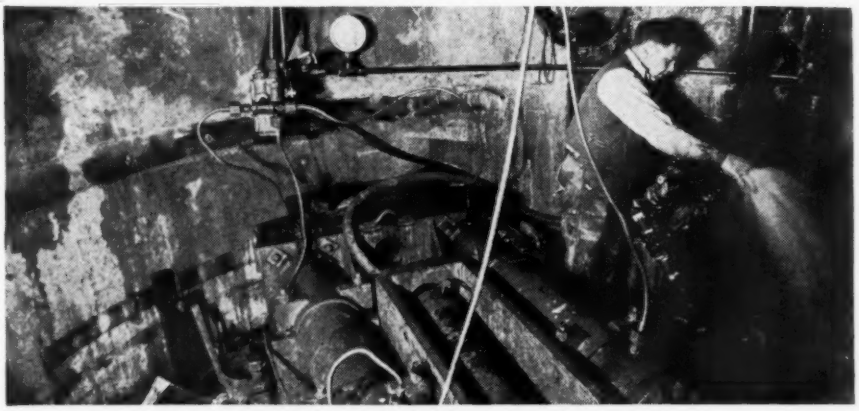
The reason for wrought iron's unusual corrosion resistance is its unusual structure. The tiny fibers of glass-like silicate slag that are threaded through the body of high-purity iron halt corrosion, and spread it uniformly over the surface. The fibers also anchor the initial protective scale, which shields the underlying metal.

It is important to remember, also, that the delivery situation on wrought iron is excellent. You can obtain it promptly, not only for industrial and municipal wells, but even for private water supply. Our General Catalog will give you full dimensional data; ask for a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

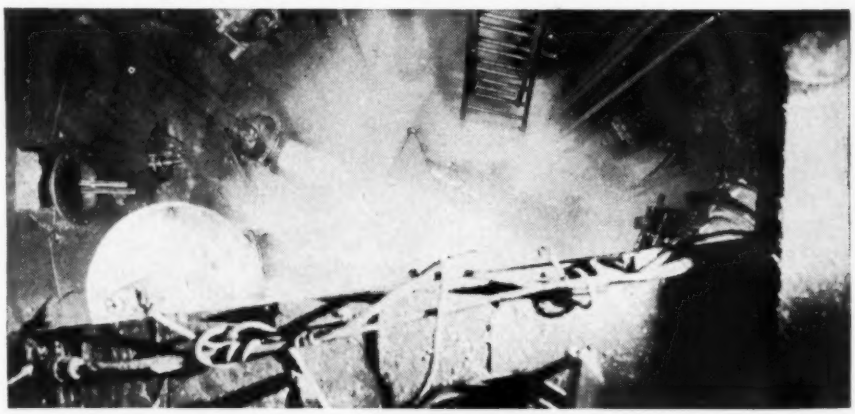


One of the screen pipes, fabricated from Byers Wrought Iron plates, attached to a digging point and ready for installation in a Ranney well.



A view at the bottom of the shaft. Screen pipes are pushed out through ports by hydraulic jacks. The pipes radiate from the shaft like spokes from a wheel.

Pressing one of the strainer pipes out through a 10" gate valve into water-carrying strata. A rubber packer restrains the outside water from entering.



Here the strainer pipe has been positioned, the jack removed, and the packer has blown out. The valve is being closed to shut off the water flow.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
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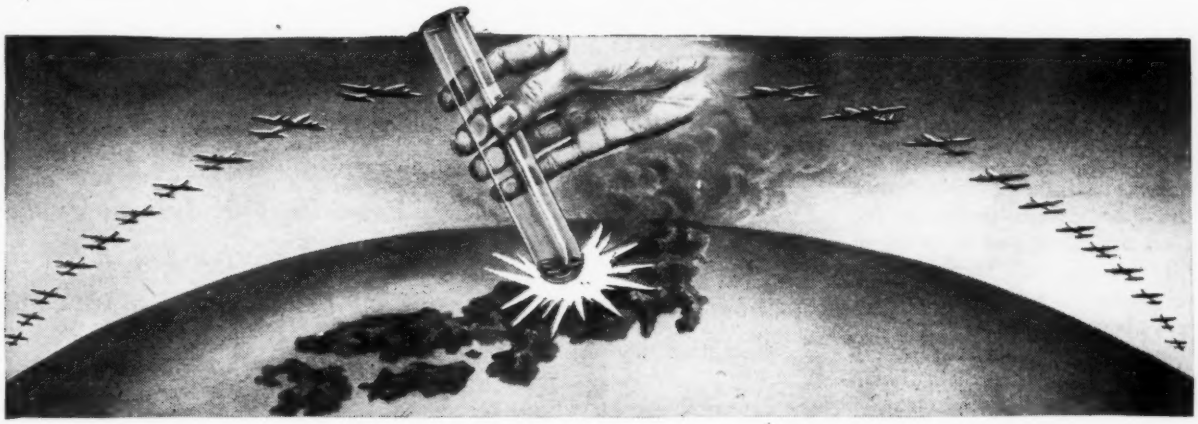


Atom Energy—New Power, New Problems

PERFECTION AND USE of the atom bomb shortened the war tremendously. It made overwhelming the already superior air, sea and land power of the allied forces. Thus the capitulation of Japan came much sooner than most people believed possible (perhaps months or years). Without question the costs and risks involved in bringing atomic power from the laboratory to the battlefield in five years are more than justified by the millions of lives and billions of dollars saved.

Yet much as that victory means to all who toiled, fought or sacrificed it will be far outweighed in the scales of history by the fact that, for the first time, the energy locked in matter was released at will, to do a specific task.

No man can now say what political, social and economic changes will result from future application of atomic energy. Present guesses, based on scanty data, range from the obvious to the grotesque. Certainly, every resource of human decency and restraint will be needed to keep muzzled this monstrous force.

Thus at the very beginning we face a major question mark in an attempt to assess peacetime possibilities of the new knowledge of atomic energy. The leaders and peoples of the world realize that they have, in this new force, something that will greatly affect their lives and habits. But the crucial question is—to what extent will they control this force in the spiritual domain and how far will industry be allowed to go in the use of this vast natural energy? Many other important questions will be encountered depending on when and how this first and most vital one is answered.

Can the reactions be handled with the degree of physical safety and predictability necessary for industrial use? Can materials for atomic-energy release be produced at costs low enough to compare with other energy sources? Only when we know these facts can we begin the engineering needed to provide mechanisms for harnessing atomic power to workaday uses.

We can hope that the war-accelerated pace of research will be maintained in peacetime, but engineers will do well to temper optimism with caution in forming opinions as to when and how atomic energy will take its place alongside fuel and water power.

Power men, whose job is energy conversion, will watch atomic-energy developments eagerly. The article on pp 64-66, reprinted in abridged form from POWER, July 1940, explains and evaluates the basic developments in atomic physics on which today's advances rest. We also suggest the survey of current developments, prepared by a special editorial committee for all McGraw-Hill publications, which is bound into this issue between pp 102 and 103. This report gives the essence of present available knowledge. As soon as further information is released, you can be assured we will give you related, dependable interpretations.

URANIUM 235—POWER FUEL OF THE FUTURE?

Now that atomic bombs have landed on Japan's soil, the facts and fancies in this article, first published in July Power, 1940, sixteen months before Pearl Harbor, deserve a second reading. No words have been added or changed in the light of subsequent events. Some have been deleted to save space

By PHILIP W SWAIN, *Editor*

▶ URANIUM, AN ULTRA-HEAVY metal, has three forms (chemists call them *isotopes*) more alike than human triplets. These are called Uranium 234, 235 and 238, the numbers being the respective atomic weights.

It has been proved by actual laboratory tests made this year [1940] on a little sliver of Uranium 235 that a relatively slow atomic projectile impinging on the nucleus of an atom of 235 will explode it, breaking the "massive" atom up into two atoms of substances about half as heavy.

More important, it has been proved that the fragments of this explosion have far greater energy than that of the original projectile. These moving fragments of a terrific atomic explosion are easily brought to rest by barriers of matter, thereby delivering their energy as ordinary sensible heat.

If every atom in one pound of 235 were thus exploded, the heat delivered for outside use would be 37,000,000,000 Btu per pound. Uranium 235, as a fuel, is equivalent to 1370 tons of 13,500-Btu coal. Directly or indirectly, this heat could make steam. This steam, with present-day turbine-room equipment, could easily be converted into 2,700,000 kwhr of electrical energy, assuming the very conservative conversion efficiency of 25%. This would be enough to operate a 100-hp motor continuously at full load for 3 years.

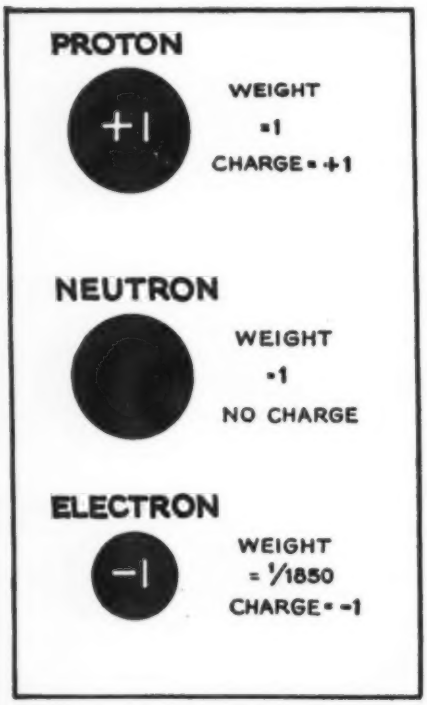


Fig. 1—The building blocks of matter

However, the wide-awake power engineer will not rush off to buy any stock in uranium power plants until he has sized up some of the difficulties.

First is the still unsolved and extremely difficult problem of commercially separating Uranium 235 from the parasitic 234 and 238 with which it is always mixed in a state of nature. Every pound of Uranium 235 recovered from natural ores is intimately mixed with about 140 lb of 238 and about 1/120 lb of 234. Getting rid of the 238 is the practical problem.

Fig. 1 diagrams the more important basic building blocks of matter—of all matter from molasses candy to arsenic, from gold to cast iron. These "blocks" are proton, neutron and electron. Proton and neutron are alike in mass ("weight") but differ electrically. Proton and electron differ enormously in mass, but have equal and opposite electrical charges. Let's call the mass of the proton 1 and its electrical charge +1. Then the mass of the neutron is 1 and its charge zero. The mass of the electron is insignificant (1/1850) but its charge is −1.

The Hydrogen Atom

Fig. 2 shows the simplest and lightest of all atoms, that of hydrogen. Here we have a "solar system" consisting of one "sun," a single proton with a plus charge, around which revolves at inconceivable velocity one "planet," a single electron with a negative charge. Plus and minus attract, so the electron tries to fall into the proton. The tangential tendency and the centripetal pull balance in the compromise of circular or elliptical motion.

Since the weight of the electron is negligible, the weight of this hydrogen atom is simply the weight of its proton, 1, the figure given in all chemistry books for the approximate atomic weight of hydrogen.

Atom Construction

Please note that Fig. 2 is not "to scale"—not by a long shot. Diameter of the hydrogen atom is about 1/100,000,000 of an inch. Even at that, the atom's diameter is about 100,000 times that of the electron and also 100,000 times that of the nucleus.

In the case of this ultra-simple hydrogen atom, the center, or "nucleus," consists of but one particle, a proton. All other elements are heavier than hydrogen, and have more than one proton in the nucleus. To balance these positively charged protons, these other elements must have an equal number of negatively charged electrons in the outer orbits. Thus, in the atom of any element, there will be as many electrons whirling around in various outer orbits as there are protons bunched in the nucleus.

In addition to these protons, the nucleus of the typical atom (not hydrogen) contains some neutrons. These add to the mass, though electrically neutral. To a fair degree of accuracy, the atomic weight of any substance is simply the numerical sum of the protons and neutrons in the nucleus of its atom.

It may be asked how the protons can possibly bunch together in the nucleus

(since their positive charges must repel) or even how the neutrons can remain in the nucleus (since they, too, are moving and should thus tend to fly out). The physicist's answer to this is a mysterious attractive force of one mass for another, which becomes very powerful at these minute distances.

The Uranium Atom

Fig. 3, picturing the atom of Uranium 235, is even more schematic than Fig. 2. It must not be taken too literally except as to counts, charges and weights. The electrons, for example, are probably moving in orbits tilted at all angles. No attempt has been made to picture the true arrangement, but the numbers indicated are correct.

The 92 moving electrons in the various outer orbits of this atom contain a lot of energy, but it is small compared with the total in the swarming 92 protons and 143 neutrons of the nucleus. Each of the 235 particles in the nucleus weighs 1850 times as much as one electron.

The energy of matter may be considered from the angle of the energy *in* the matter or of the energy one can *get out*. From the first point of view all forms of matter are approximately equal, having an internal atomic energy of about 40 trillion Btu per pound.

To release some of this energy, the atom has to be broken up, or break up of its own accord. Radium is the classic example of the latter.

Other atoms have been broken up by bombardment with fine particles—usually high-speed protons or neutrons, traveling 10,000 miles per second, or faster. The resulting explosion may give off energy, but the number of direct hits on the tiny nucleus is so small, and the cost of generating the projectile is so large, that it's "no sale" as far as power generation is concerned. But Uranium 235 is different.

Suppose you use a "very slow" neutron projectile, one moving about 1000 ft per second. If this projectile happens to hit the nucleus of an atom of Uranium 235 it will split the atom up into two atoms of new substances of about half the original atomic weight. These two fragments fly apart with catastrophic violence. "Spare parts" in the form of 2, 3 or 4 neutrons (average about 3) will be left over from the atomic split and will fly out freely with enormous velocity. The energy in these exploding fragments will be many times that of the projectile used—as if a ton of dynamite were set off by one small detonator.

One interesting thing about 235 is

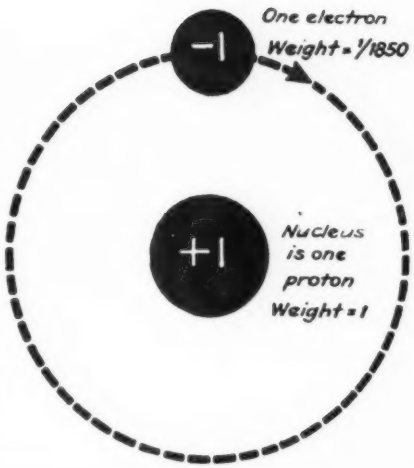


Fig. 2—Hydrogen atom is the simplest and lightest of all. One electron (weight 1/1850) revolves around a nucleus of one proton (weight 1)

that it is broken up much more easily by a slow projectile than a fast one. There appear to be two reasons for this. First, the Uranium 235 nucleus is so unstable that a "soft" blow will smash it as surely as a hard one. Second, a "slow ball" is much more likely to make a hit.

Actually, the nucleus is much smaller in proportion to the size of the atom than shown in Fig. 3. The chance of a given neutron being aimed straight at this bull's eye is very small. One must generally count on the projectile being "sucked in" as it passes. As already noted, the protons and neutrons in the nucleus are drawn together by some powerful dominating force when they get close enough. This same force will act on a passing neutron projectile. A fast shot will be deflected little, and will probably miss, as shown at the top. The "slow ball" shown lower down, will probably be sucked in to land a hit, if its original line of motion is reasonably close to the nucleus.

Search for a "Chain"

The idea of atomic power calls for a "chain" reaction. We find this often in nature. You light one leaf in a pile with a match and the whole pile becomes a bonfire.

Applying this process to a mass of Uranium 235, you would explode the first atom with a neutron projectile fired from the outside. You might expect neutron fragments from the first explosion to explode several additional atoms, and so on. Thus the disintegration of atoms would continue of its own accord until the entire mass was converted into lighter elements and the whole available 37 billion Btu per pound released.

Chains so far obtained with Uranium 235 have not been self-perpetuating for two reasons. One is that the experimental work was conducted with a thin film of 235. Practically all the neutrons released by the primary explosions flew off without hitting any more uranium. Most of the shots were wasted, went wild.

Now a bungling rifleman, who might miss a lone tree, couldn't miss hitting some tree or other if he fired at random in a deep forest. Same with atoms. Imagine a mass of several pounds of Uranium 235, with a cavity in the center, wherein a single neutron is released. If it misses a few nuclei it will continue on until it finally hits one and explodes it. From one to four high-speed neutrons fly off from the explosion. Each of these eventually finds a nuclear target, so the explosions build up in a geometrical series.

Here would seem to be the basis for the catastrophic explosion already mentioned, but physicists suggest that it cannot take place with Uranium 235, because nature has installed her own "fire extinguisher" in this element. The neutrons thrown off by atomic explosions are moving too fast to disrupt other atoms. They have to be slowed down artificially. Hydrogen atoms, in layers of water, are the best brakes. After the neutron has been slowed down enough it will find another uranium nucleus and explode it. In this way you get a retarded chain reaction, such as you get with coal burning in air.

Reaction Is a Slow Chain

So you perforate your uranium mass with voids or pipes full of water. When the reaction is started the water wastes the excess energy of the projectiles and the reaction goes on as a slow chain. Why not an instantaneous chain? Because if the reaction went faster than the water fed could carry away the heat as steam, the steam would be superheated to such a high temperature that it could not sufficiently slow down the neutrons and they would cease to smash other atoms.

Briefly, present experiments indicate that a true chain reaction could be started in a mass of perhaps five to 50 pounds of Uranium 235, using very simple apparatus (perhaps none at all; competent physicists tell me that the neutrons in the cosmic rays always present should be sufficient to start the process). Thereafter the evolution of energy would proceed at a rate determined by the rate at which water was pumped through the mass. When water flow was stopped the evolution of en-

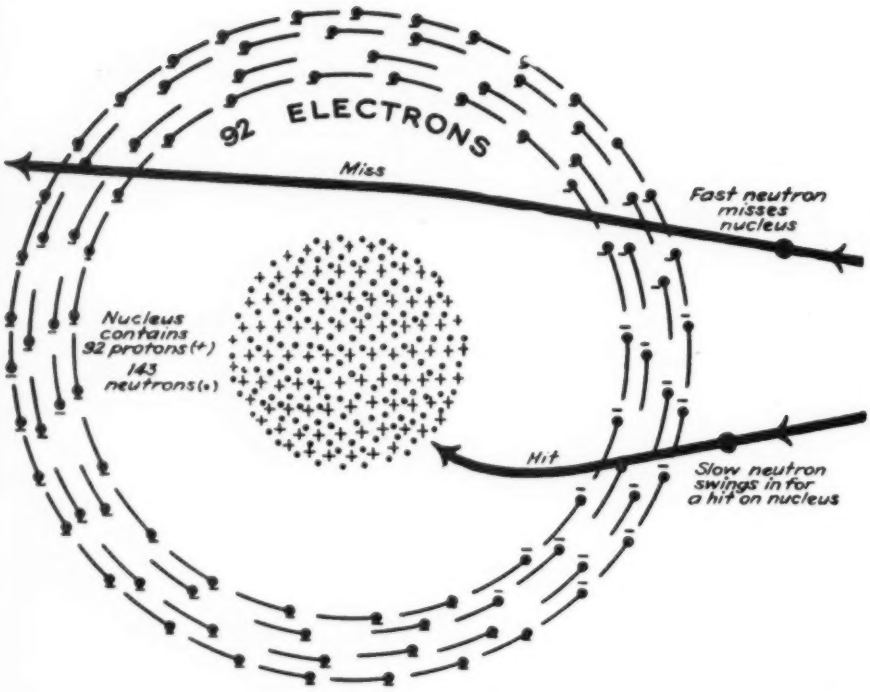

92 ELECTRONS
Miss
Fast neutron misses nucleus
Nucleus contains 92 protons (+) 143 neutrons (•)
Hit
Slow neutron swings in for a hit on nucleus

Fig. 3—Atom of Uranium 235 contains 92 protons (+) in the nucleus, electrically balancing 92 electrons (—) in the outer orbits. Since electron weight is negligible atomic weight = 92 + 143 = 235. Sketch is purely schematic

ergy would cease or reduce to a small value.

All water pumped through would be instantly converted to high-temperature steam.

The history of the laboratory work behind this sensational discovery is intensely interesting, but there is space here for only the briefest summary: In January, 1939, Dr O Hahn and Dr E Strassman, of Germany, bombarded uranium with neutrons, and thereafter found traces of lighter elements, having about half the atomic weight of uranium.

Hearing of this, three American groups, within a period of a few weeks, proved by tests that the bombardment does actually split uranium into lighter substances, with tremendous energy release. First in this race, by a few days, were Prof John R Dunning, Prof Enrico Fermi and collaborators, at Columbia University. A few days later came confirmation from L R Hifstad, R B Roberts, M A Tuve and associates, at Carnegie Institution, of Washington.

Many laboratories in Europe and America immediately went to work on this problem, but none succeeded in getting a true chain reaction with commercial uranium. It was suspected that Uranium 238, constituting over 99% of the uranium used, was acting as "damper." The obvious next step was to test the three isotopes separately.

First they had to be separated. This was accomplished in the spring of this year [1940], first by Prof Nier, of the University of Minnesota, and two weeks later by scientists in the General Electric research laboratory. Thereafter the Columbia scientists (Prof Dunning, Prof Fermi, Dr E T Booth and Dr A V Grosse) were able to bombard each isotope separately. They found that 238 was not at all receptive, nor was 234, whereas 235 gave the spectacular results already described.

In all the laboratories, the first step in the bombardment technique is to produce very high-speed projectiles, such as protons. The protons are accelerated either by a straight high-voltage electrical field, or by an electromagnetic device known as the cyclotron. The resulting high-speed protons are allowed to hit a beryllium target. This, in turn, gives off a shower of high-speed neutron projectiles to attack the sample of uranium.

The best uranium ore is pitchblende, which has been used for years as the commercial source of radium. At present there are pitchblende mines in western Canada, in Australia, in the Belgian Congo and in Germany. There are no rich deposits in the United States but some low-grade uranium ore is found in Colorado in the form of Carnotite. Uranium oxide is 65 to 90% of the total weight of pitchblende.

Present [1940] price of uranium oxide (U_3O_8) is about $5.00 per pound, whereas the commercial uranium metal sells for about $40.00. It is easy to imagine that this could be reduced to $10.00, or less, if a commercial demand arose. However, this pound of commercial uranium metal would contain only 1/140 pound of the desired 235 isotope, so that the cost of the latter, even if there were no extraction costs, might be over $1000 per pound.

It probably won't make any particular difference whether this isotope is separated in metallic form, or as an oxide. In any case, the problem of separating isotopes, so nearly similar in all physical and chemical properties, is one of enormous difficulty. This more than any one thing may delay for decades the application of Uranium 235 as a commercial fuel.

Future Applications

Waving aside all these practical difficulties, and looking forward to an imaginary future state in which they have been solved, it is interesting to attempt prediction of the effect of the generation of steam and power. To idealize the case, let us assume that uranium cost per unit of energy output is negligible, and that plant investment and labor costs are the same as now.

In that case, for a power or steam station the total possible saving would be the present cost of coal. In a central station this saving would run from 2 to 4 mils per kwhr, less important than the savings produced by the change from the carbon filament lamp to the tungsten lamp.

Because of its extreme concentration of energy, Uranium 235 has an immense appeal to the imagination as the future fuel for house heating and for the powering of planes, autos, ships, etc.

In the household ten tons of coal could be replaced by 1/140 lb of uranium. A car that runs 15 miles on one gallon of gasoline would run about four million miles on one pound of uranium.

There is at least one joker in this delightful picture. In the case of the home you might have to stock up with fuel for the next thousand years, because (it now seems) the 235 would not "burn" unless you had a mass of at least five pounds. Same may hold for automobiles. Who would want to "fill the tank" for twenty million miles?

Obstacles such as these make early practical application of atomic power on a substantial scale unlikely. Nevertheless, Uranium 235 gives us the "makings" of atomic power plants. In the light of the history of science and engineering, eventual application seems probable—perhaps within our lifetime.

Full-Automatic Skip Hoist Serves Four Storage Silos

Gilbert Lindgren, electrical maintenance foreman, Troy coke plant, N. Y. Power & Light Corp, describes operation and control circuits of a skip hoist. Without attention it loads, hoists, transfers to one silo in a group of four, lowers and unloads the bucket and then returns it to the loading pit

▶AT OUR PLANT a full-automatic skip hoist stores coke in a 4-silo installation. After the selector switches are set to fill a given silo and the control energized by pressing a pushbutton the equipment goes into service and automatically delivers coke from a track hopper. When that silo is full, resetting the selectors transfers delivery to another. Directed by two groups of cam-actuated limit switches, Fig. 4, this automatic control is simple.

Fig. 1 shows the general arrangement of silos and hoisting equipment, with the skip bucket counterweighted by a hoist-drum counterweight. The hoist cable connects to the opposite end of the drum from the counterweight cable and leads around sheaves S_1 and S_2, under two sheaves on the skip bucket, over sheave S_3 and connects to the anchor arm, enlarged in Fig. 2. One end of each of two trolley cables connects to opposite ends of the trolley, then leads around two sheaves and connects to the trolley-driving drum.

When the hoist starts it lifts the loaded bucket to the trolley and stops. The trolley drive then starts and transfers the bucket over the silo for which the selector switches have been set, say silo No. 4. Here the trolley stops, the hoist starts and lowers the bucket to the coke in the silo.

When the bucket lands in the silo its bottom unlatches and the hoist cable becomes slack enough to let spring *S* move the anchor arm, Fig. 1 and 2, to the right to close limit switch *LS* 14. Closing this switch reverses the hoist control to lift the bucket to the trolley carriage, which returns it to a point above the hoistway. Here the bucket is held for about 10 sec to let it stop swinging, when the hoist lowers it to the loading pit. A complete operating cycle to the farthest silo requires 2 min and 22 sec.

The hoist is driven by a 15- and 30-hp 2-speed squirrel-cage motor with windings grouped to give 600 and 1200 rpm. A 5-hp 1200-rpm gearmotor drives the trolley drum. Bucket-hoisting speed averages 200 ft per min and its cross-travel speed on the trolley is 100 ft per min. Thermal-type overload relays provide protection for the hoist and trolley motors.

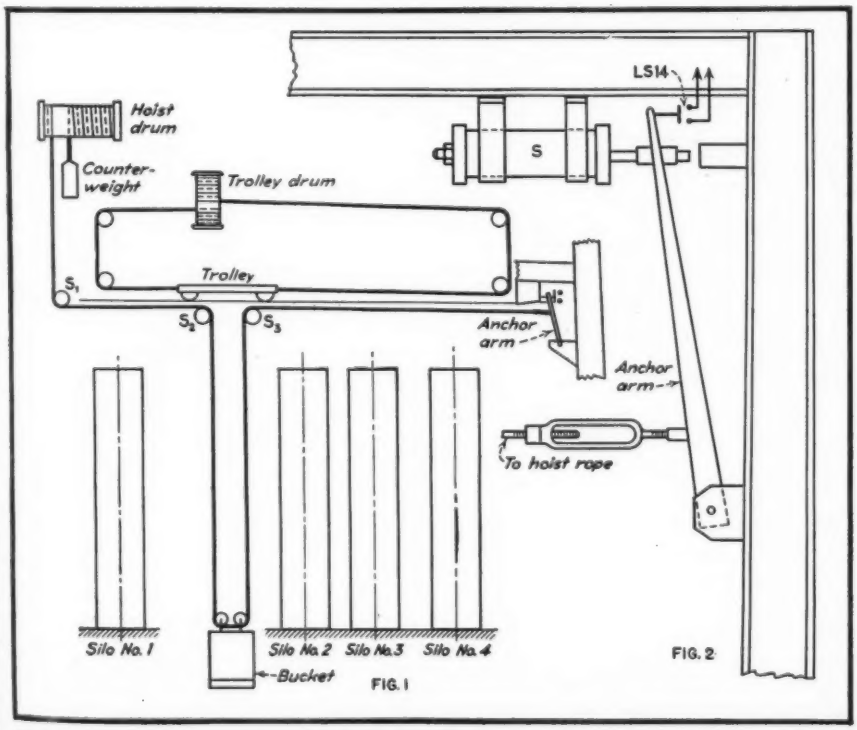


Fig. 1—General arrangement of silos, hoisting and transfer-trolley equipment. Fig. 2—Enlargement of hoist-rope anchor-arm equipment that is shown in Fig. 1

Hoist-Motor Connections

Fig. 3 shows the hoist-motor connections to the direction and speed contactors. To start the hoist the low-speed contacts close. When the motor has accelerated on its low-speed windings, low-speed contacts open and high-speed close. As the bucket approaches the transfer-trolley the hoist motor is switched back to slow speed to land the bucket. Lowering speeds on the hoistway are similar to those for hoisting.

Fig. 5 is a single-line diagram of the control, which operates on 440-v power. When the operator selects the silo to fill, say No. 4, he closes selectors *S*3 and *S*4 to short-circuit limit switches *LS*7 and *LS*17. Operator also closes the double-throw trolley switch to the direction for silo 4 and closes switches *A*. The latter on the control panel is a 4-pole single-throw unit. To start the hoist, operator closes the start button, which completes the under-voltage relay-coil-*UV* circuit. The latter closes the *UV* contacts to energize the control. Hoist is now in full-automatic operation. Closing *UV* contacts completes a circuit for time-delay relay transformer primary *TH*. Time-delay relay coil is now energized through *LS*2 limit switch, and the relay starts timing the closing of its contact *TH*.

Time-delay relay holds contact *TH* open long enough for the bucket to fill. When *TH* contact closes, it completes the circuit for the up-direction contactor coil *U* of the hoist-motor starter.

When this contactor closes the up-direction circuit it also closes three auxiliary contacts, *U*1, *U*2 and *U*3. Auxiliary contact *U*3 closes *LS*, the slow-speed contactor-coil circuit. Contact *U*3 also closes the brake-coil circuit so that the brake releases and the hoist starts on slow speed. Shortly after the hoist starts, *LS*2 limit switch opens the timing-relay coil circuit, and contact *TH* opens, but *U* contactor-coil circuit remains closed through contact *U*1.

After the bucket has been lifted about 10 ft, limit-switch contact *LS*3 closes relay *CR*6 coil circuit. This relay opens *CR*6 contact in *LS* slow-speed contactor-coil circuit and closes *CR*6 contact in *HS* high-speed contactor-coil circuit. This switches the hoist motor from slow to high speed. As the bucket approaches top of hoistway, limit switch *LS*11 opens to break the circuit through *CR*6 relay coil and high-speed contactor coil so that the hoist returns to slow-speed operation.

As the bucket comes into the trolley, top-limit switch *LS*1 opens and breaks the up-direction switch-coil-*U* circuit. This contactor and slow-speed *LS* contactor open and the hoist is stopped by applying the brake when auxiliary contact *U*3 opens. As the bucket pulls into the trolley, limit switch *LS*6 closes to energize *TN* coil of the trolley-drive-motor contactor. The trolley starts and transfers the bucket to the center of silo No. 4, ready for lowering.

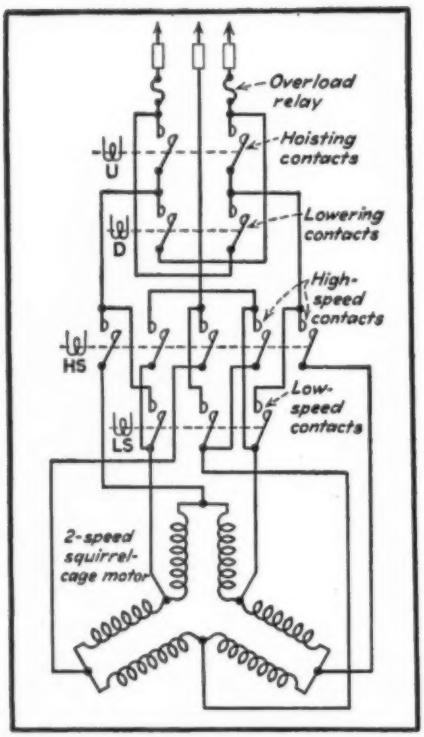


Fig. 3—Two-speed squirrel-cage hoist motor; its direction and speed contacts

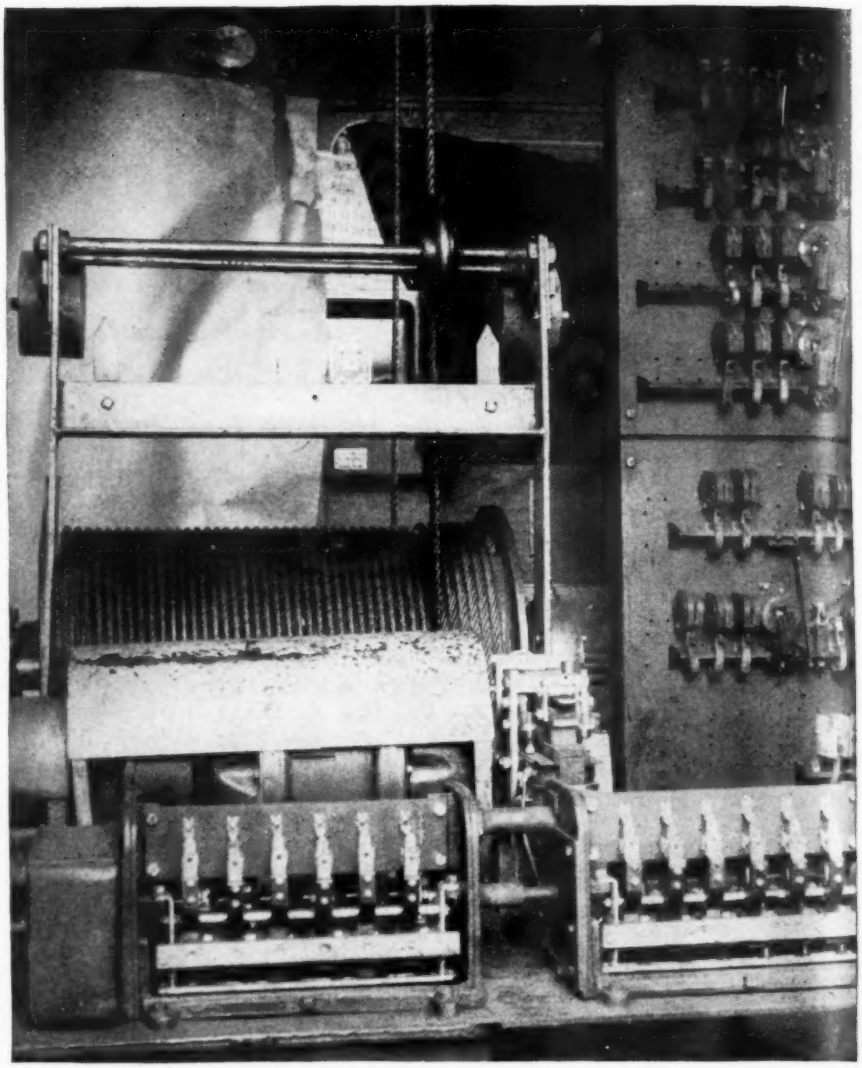


Fig. 4—The hoisting equipment is comparatively simple and the automatic control is directed by two groups of cam-actuated limit switches, in foreground

When the trolley traveled toward silo No. 4 it opened limit switches *LS*7, *LS*17 and *LS*19 and closed *LS*8, *LS*18 and *LS*20. Opening *LS*19 breaks the trolley-motor contactor-coil circuit to stop the trolley with the bucket over silo No. 4. Closing *LS*20 completes a circuit for *CR*4 relay coil through *LS*8, *LS*18, *LS*20, *CR*4 coil to the other side of the line. This coil closes *CR*4 contact in the down-contactor coil-*D* circuit and in *CR*5 relay-coil circuit.

Energizing down-contactor coil-*D* circuit closes contact *D*2 in the slow-speed contactor-coil *LS* and brake circuits to start the hoist lowering the bucket into the silo at slow speed. Continuing down at this speed the bucket lands on the coke in the silo and trips dogs that unlatch its bottom. At the same time the hoist cable becomes slack and spring *S* moves the anchor arm to right to close contact *LS*14. Closing this contact completes a circuit for *CR*5 relay coil, which closes contacts in up-hoist circuit and in the transfer-relay circuits *CR2T* and *CR*3.

A circuit for *CR2T* coil is through *LS*8, *LS*18, *LS*20, the coil itself and *CR*5 contact. Energizing *CR2T* coil transfers contacts *TR* to their up-position and *TR*1 down. These contacts lock in position so that they remain closed after *CR2T* coil circuit is broken. Before coil *CR*3 circuit was broken by *TR*1 going to the down-position, *CR*3 relay coil was energized to open *CR*3 and *CR*2 contact in the trolley-motor out-travel circuit and to close *CR*3 and *CR*2 in the return circuit.

Closing contact *CR*5 in the up-circuit bypasses the timing-relay contact *TH* to energize the up-coil. This coil closes contact *U*3 in the slow-speed contactor-coil circuit and the hoist lifts the bucket. Loading the hoist cable pulls the anchor arm, Fig. 2, to the left and opens contact *LS*14. This breaks the *CR*5 relay-coil circuit and its contacts open in the transfer-relay coil and up-contactor-coil circuits. Up-contac-

tor coil remains energized through *U*1 contact.

When the bucket again approaches the trolley, *LS*1 limit switch opens to stop the hoist, and *LS*6 contact closes to energize trolley-contact-coil *TS* and return the bucket to the hoistway where opening contact *LS*10 stops the trolley. At the same time contact *LS*11 closes in the high-speed hoist-motor control circuit. Closing *LS*11 completes a circuit for the timing-relay coil *TL* circuit, contact *CR*3 being closed by transfer-relay coil *CR*3.

By the time the bucket has come to rest, timing relay closes its contact *TL* to complete a circuit through down-coil *D*. Energizing this coil closes contacts *D*1 and *D*2. The latter energizes the slow-speed contactor coil and the brake-coil circuits to start the bucket down the hoistway. When the bucket starts down, limit switch *LS*6 opens to disconnect both trolley circuits, completely and *LS*1 closes. Bottom of bucket is closed, as it goes down the hoistway, by striking a cushioned latching dog.

After the hoist motor accelerates to slow speed, limit switch *LS*3 closes the circuit through *CR*6 relay coil. This relay, as previously explained, opens *CR*6 contact in the slow-speed circuit *LS* and closes *CR*6 in the high-speed circuit *HS*, to accelerate the hoist to full speed. As the bucket approaches the slow-speed zone at the bottom of the hoistway, limit switch *LS*3 opens *CR*6 relay-coil circuit to switch the motor to slow speed.

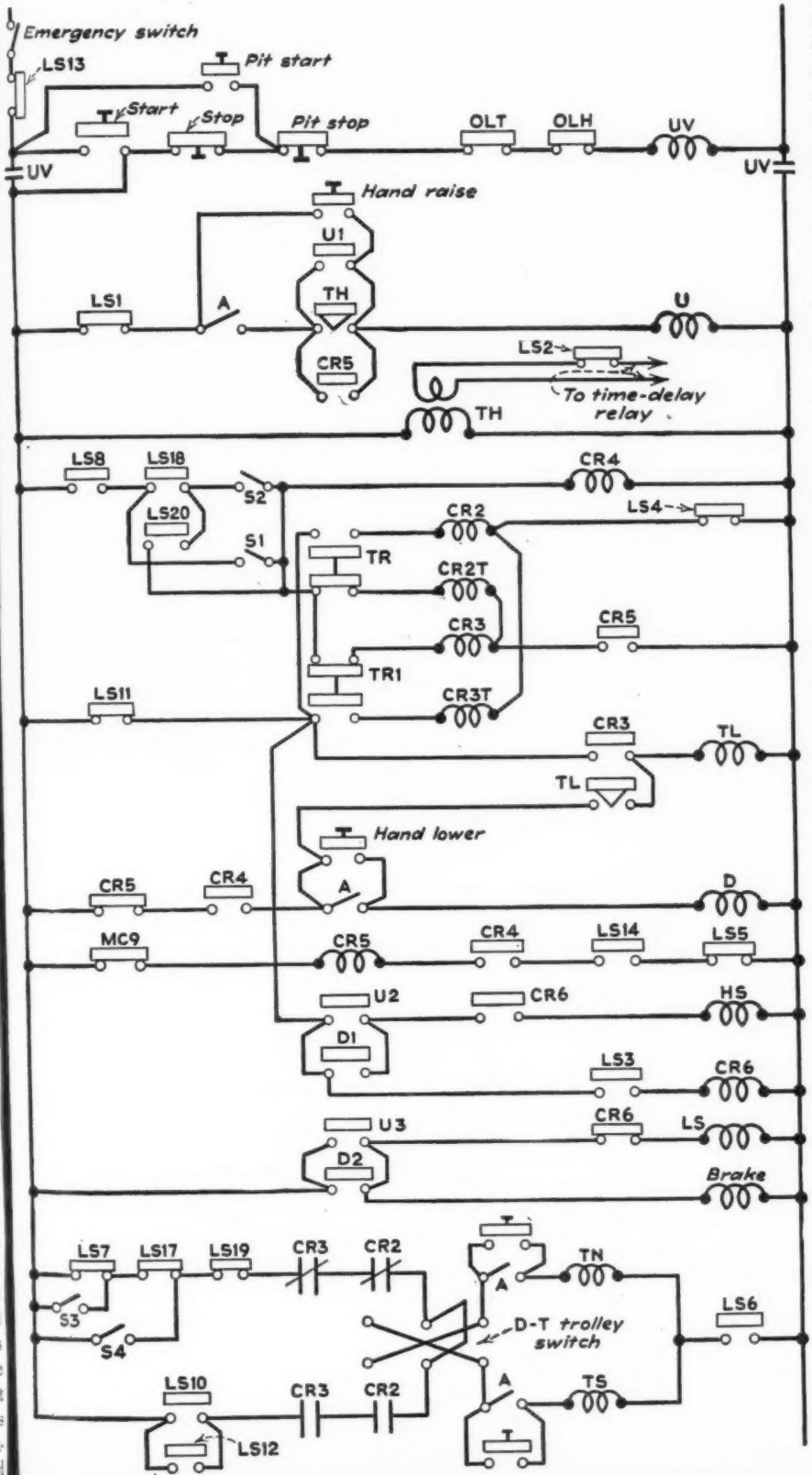


Fig. 5—Single-line diagram of the 2-speed hoist-motor and transfer-trolley motor-control circuits designed for operation on 440-v alternating current

Transfer-Relay Circuits

As the hoist bucket comes into the pit *LS*4 and *LS*2 close simultaneously. Closing of *LS*4 completes a circuit for transfer relay coils *CR*3*T* and *CR*2 to reset these relays for the next hoist trip. It also closes *CR*3 and *CR*2 contacts in the out-travel trolley-control circuit and opens them in the trolley-return control circuits. When relay-coil *CR*3 was energized it opened *CR*3 contact in timing relay-coil *TL* circuit, which caused this relay to break the down-contactor circuit and stop the hoist as the bucket came into loading position.

Closing limit switch *LS*2 completes timing-relay coil circuit and it starts timing out for the next trip. When the bucket has been in the pit long enough to load, the timing relay closes its contact *TH* and the hoist starts and repeats the operations previously outlined.

This description indicates that even though the hoist is practically human in its performance, the control is quite simple. Principal parts of the control are limit switches and relays to start and stop the hoisting and lowering of the bucket and then to transfer it to and from the selected silo.

It is not general practice to use squirrel-cage motors for reversing service. The hoist motor, on the other hand, has given no trouble whatsoever although it receives quite a jolt when reversing in the silo. Of course, ample feeder and power capacity are necessary to avoid voltage disturbances.

Operators' Guide to Diesel Lubrication

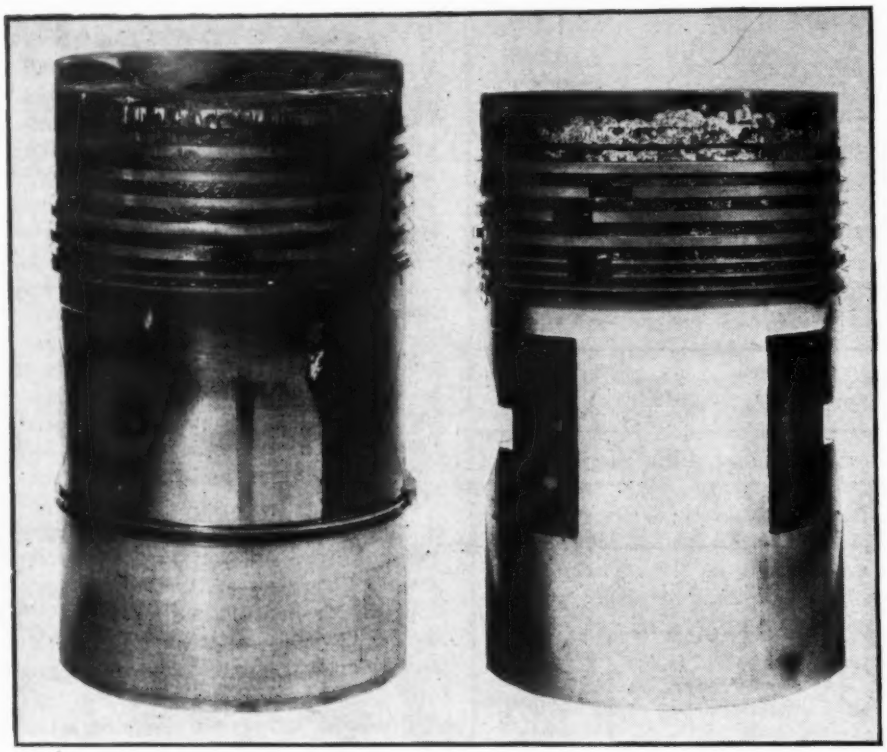
Here is a straightforward outline of the job a diesel lubricant must do and what happens to it in service. With a clear understanding of fundamentals, the operator can derive practical benefit from more complex specialized discussions

► SINCE THE ADVENT of the high-speed engine, more has been written about lubrication than any other phase of diesel operation. So much has been published that the picture is liable to confuse any but the expert and, consequently, the operator, to whom the matter is of tremendous practical importance, may despair of trying to fit the numerous detailed discussions into any orderly and useful pattern. Yet such a pattern does exist. The key to it is a clear understanding of the work lubricating oil does in a diesel engine and what happens to the oil as it performs that work. With this understanding of fundamentals as a sort of road map, the operator can steer his way through the specialized and complex discussions of carbon formation, varnishing, ring sticking, sludging, etc., to practical answers for his specific problems.

Lubrication of a diesel engine breaks down into three parts: (1) providing an oil film between shafts and bearing surfaces at main, crankpin and wristpin bearings (2) performing the same function for camshaft, valve gear and various engine auxiliaries and (3) maintaining an oil film between piston and cylinder walls.

Although bearing pressures run high in many diesels, lubrication of the rotating shafts is not essentially difficult. The wristpin bearing, if not of the full floating type, may present a problem because the unit pressure runs high and there is no rotation. Camshafts and valve gear present a variety of lubrication jobs—sliding friction between valve stems and guides, pressure between tappets and stems, and rolling friction between cams and followers, camshafts and bearings—but the conditions are not unusually severe. In fact, if this were all of the diesel-lubrication job, much less would have been written and done about it.

Because the diesel is an internal-combustion engine, the major lubrication problem centers in the cylinders. The oil must do two things: lubricate the cylinder walls, piston and piston rings, while assisting the rings to form a seal and transfer heat. To grasp the essential difficulty of this task and how it influences all other phases of engine lubrication, let's see what happens to the oil on each stroke of a 4-cycle engine.



Piston at left, from laboratory engine, operated 108 hours at full load. Wrong lubricating oil caused hard lacquer-like deposits around top rings; darkened piston skirt shows blowby. Effects of lower temperature in oil-ring area is indicated by absence of deposits. Piston at the right, correctly lubricated, shows free rings and clean surfaces after 1000 hours of operation at full load

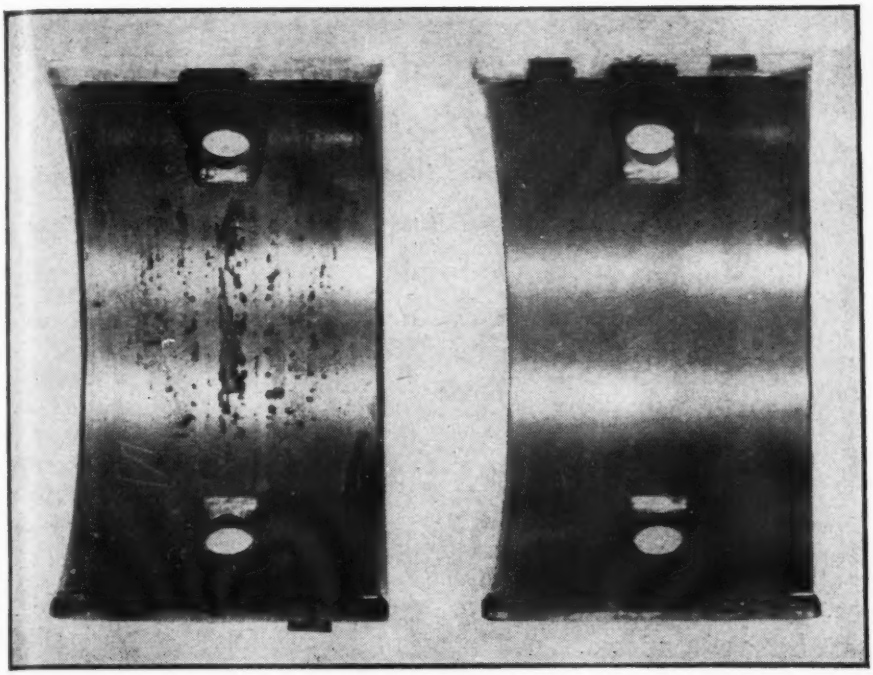
Lubrication Cycle

On the suction stroke, the piston rides on an oil film left from the previous stroke, while the oil in the clearance space between the rings assists them in forming a seal to prevent leakage of air or vapor from the crankcase into the cylinder.

The oil film tends to remain for the following compression stroke, and is reinforced by oil carried with the piston on the upstroke. The oil supply collecting on the advancing side of the piston rings serves to help prevent leakage of the air being compressed. Thus compression pressure obtained depends on the seal-forming properties of the lubricant as well as on the mechanical condition of cylinder, piston and rings. During the compression stroke, air temperature rises gradually but not enough to do any damage to the oil film until near the end of the stroke when the piston covers most of the film.

The oil film placed on the cylinder walls during compression lubricates the piston on the working stroke. As the piston moves down, exposing the walls to the high temperature of the burning fuel, the flame comes in contact with the oil film, but only after it has served its purpose and lubricated the piston on the downstroke. The oil takes a real beating on this stroke; oil between rings and between piston and cylinder wall endures high gas pressure, the exposed film reaches high temperature and is contaminated by ash and other impurities remaining after the fuel oil burns.

On the exhaust stroke, the piston



Acid products from lubricating oil have badly corroded the bearing at the left while that at the right, lubricated with an oil highly resistant to oxidation, remains in excellent condition after having operated for a 50% longer period

moves up over a film that has suffered more or less damage on the previous stroke and may thus be inadequate. If the oil possesses the proper characteristics, however, and has been applied in sufficient amount, enough lubricating value remains to do the job, with assistance from the film on the piston. At the end of this stroke, the piston has spread enough fresh oil on the cylinder walls to renew the film fully for the next cycle.

During these operations, the oil film on the cylinder walls has been performing a third function in addition to lubricating and forming a seal. It acts as a link in the heat-transmission path from the cylinder space to the water jackets. A substantial part of the heat released by combustion flows into the piston crown. As the only points of contact with the cylinder wall, the piston rings carry part of this heat to the cylinder jackets and this heat must, of course, flow through the oil film. On pistons cooled by oil or water a major part of the heat is removed by the circulating medium.

In modern diesel engines, the lubrication functions are carried out positively as far as possible. Most engines have a pressure circulating system to lubricate main and connecting-rod bearings and many extend this system to include camshafts, valve gear and auxiliary bearings. On small engines, cylinder walls are often lubricated by splash from the crankcase: on large engines it is usual to install force-feed lubricators to supply the cylinder walls.

It is not too difficult to find a lubricant that performs the work outlined above nor to devise a satisfactory system for delivering the lubricant to the desired spots in the right amounts. The difficulty arises from the fact that the conditions involved in engine operation cause all known lubricants to deteriorate in service, becoming inadequate sooner or later for the job. Such deterioration occurs in the lubrication of most machinery; the high temperatures and pressures of diesel work make the action much faster. And this represents the difference between the lubrication of large slow-speed engines and small high-speed units. The same kind of changes take place in the oil of a heavy-duty engine, but they occur at a slower rate and in a much larger body of oil. Consequently, the results, which are much less evident over normal operating periods, are likely to be regarded as less critical.

Lubricating oil deteriorates in service because of changes that take place in the oil itself and because of contamination from outside sources. Let's look first at the changes that occur in the oil itself. It would be natural to think that most of the trouble would occur in the film exposed on the cylinder wall during the power stroke, but such is not usually the case. Part of the oil may burn, but if it burns cleanly no ill effects follow. Some oils in burning leave behind trouble-forming deposits but even this does not represent a major problem. A commoner source of trouble is the effect of high temperatures in the piston-ring area; these cause petroleum oils to crack or break down in molecular structure, a reaction roughly similar to that which occurs in refinery cracking operations. Carbonaceous and tarry products result that play a part in ring sticking and other piston and ring troubles.

Oxidation Changes

Actually, the major trouble is liable to have a less spectacular but more insidious origin. Oxidation probably takes the biggest toll of lubricating oils. This action goes on to some extent whenever oil is exposed to air carrying oxygen, but it reaches troublesome proportions when oil and air mix intimately at high temperatures. It has been found that most good lubricating oils in use today prove relatively stable —resistant to chemical change—at temperatures below 140 F and that as temperature is increased the rate of change doubles for each 18- to 20-F temperature rise.

Combination of petroleum hydrocarbons and oxygen forms organic acids of two general types: (1) volatile acids having low molecular weights and low boiling points, which are usually highly corrosive, and (2) acids having high molecular weights and high boiling points which play a part in the formation of gums and lacquers. Organic acids formed by oxidation are soluble to some extent in the unoxidized lubricating oil: the volatile acids are driven off whenever oil temperature exceeds their boiling point and the high-boiling-point acids tend to come out of solution at high-temperature spots or to precipitate at low-temperature spots.

These oxidation products lie at the root of a number of the diesel's lubricating problems. If allowed to become sufficiently concentrated, organic acids

(*Continued on page* 150)

CORRECTION

In the August *Power* "Progress Report on Gas Turbines," a drafting error made the chart at the top of p 79 incorrect in one detail. This chart showed the cycle efficiencies obtainable with various combinations of compressors, turbines, combustion chambers, regenerators and intercoolers. In the bar representing 32.5% efficiency, two intercoolers and two regenerators were shown instead of one each, the correct number.

Standard Nozzles Mean Better

Heat Exchange Institute pioneered to develop standard nozzles for measuring air flow in ejector tests. Uniform design and precision manufacture insure accurate duplication of flow measurement impossible with homemade nozzles

By HOWARD S BEAN, *National Bureau of Standards*
W H REYNOLDS, *American Instrument Co*
RAWLEIGH M JOHNSON, *Ingersoll-Rand Co*

► FOR THE PAST EIGHT YEARS the Heat Exchange Institute has progressed steadily in development of standard test procedures for steam-jet vacuum pumps. Having published its first test code in 1938, the committee in charge turned attention to improved instrumentation.

Among the first instruments they examined was the flow nozzle. Although reliable manufacturers were making standard instruments for measuring temperature and pressure, the factory tool room usually produced its own homemade nozzles. The inevitable variation in design and workmanship resulted in lack of uniformity in flow measurement, particularly in the smaller sizes. This wide diversity in the flow nozzles that the industry then used is shown in the representative examples in Fig. 1.

There was also considerable confusion regarding the essentials of the flow nozzle among engineers concerned with fluid flow. Except general features such as the "well-rounded throat entrance" and "smoothly polished surface finish" they had reached no settled agreement on design details. They did not well understand the importance of pressure-tap locations, diameter ratios, and Reynolds-number relationships in their effect upon the flow coefficient. Reluctance to discard old nozzles in favor of newer designs perpetuated the confusion.

Many examples were found where the tapered pipe thread caused the nozzle throat to contract when wrench pressure was applied. Furthermore, this type of thread invariably resulted in mutilation of the nozzle due to forced use of a heavy wrench.

Throat diameters were carefully measured for a large number of specimens by using test plugs cast of a low-melting-temperature metal. Practically always diameters measured were appreciably larger than those indicated by the stamping.

The cast plugs also revealed defects such as machining, tool marks, and poor workmanship in blending the radius of the entrance into the exit cylinder. In many instances, the exit end of the nozzle was divergent, a result of frequent cleaning with abrasives.

The necessity of actually calibrating small flow nozzles was not generally appreciated. Belief was prevalent that published flow coefficients could be used confidently with almost any of the nozzle designs having a rounded entrance, 0.98 being a common figure. Failure to apply the well-known Reynolds-number relationship for approximating the flow coefficients of extremely small nozzles often accounted for appreciable error. These experiences showed the ejector industry's need for better instruments to measure air flow.

To obtain a high degree of accuracy and promote a favorable reception from the public, the committee believed a design embodying the best available research to be essential. Homemade nozzles could never be uniformly dependable; manufacture was clearly a job for the experienced instrument maker. It was also realized that a true standard could not be had without calibration by a competent and recognized authority. Foreseeing the potential benefits the Institute elected to finance the development of flow nozzles for all of its members.

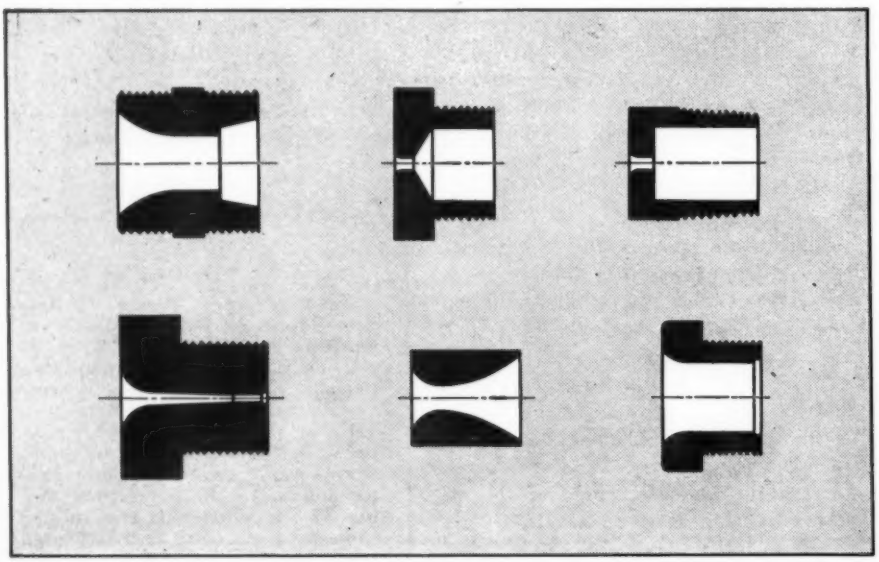


Fig. 1—Diverse designs used in most previous tests could not be depended on for uniform results; they were often poorly machined and contoured

Nozzle Size and Design

In testing the majority of steam-jet vacuum pumps, capacities are measured with atmospheric air as the fluid pumped. Of necessity, the nozzle is placed on the suction side of the jet. The majority of manufacturers find it convenient to operate the nozzle with high-pressure flow, the flow being regulated by a selection of nozzle sizes, or a combination of them. With this arrangement, the nozzle serves the dual function of a measuring device and a throttling valve. The term *pressure* refers to the *differential pressure* across the nozzle rather than the absolute pressure of the fluid. In the high-pressure method the nozzle discharge pressure is usually the critical pressure; in the low-pressure method it is higher than the critical.

The high-pressure method has many practical advantages and is generally satisfactory since the jet suction pres-

Fluid-Flow Measurements—I

Fig. 2—Average difference in the flow coefficient between nozzles of ten sets like this one ranges from 0.1 to 0.2%. Set includes ten sizes from 1/16 to 1 in.

sure seldom exceeds the critical pressure at the nozzle throat. Occasionally however, it is necessary to determine flow rates at jet suction pressures close to atmosphere. For this condition, it is customary to use an auxiliary expansion tank and a throttle valve between the nozzle and the ejector suction. The arrangement is commonly known as the low-pressure-nozzle method.

Compared to blowers and air compressors, ejector capacities are usually small and flow-nozzle size requirements vary between 1/16 and ½ in. A 1-in. nozzle is rarely needed. These small diameters account for much of the difficulty encountered in manufacture.

After a careful study of size requirements, ten flow-nozzle diameters varying from 1/16 to 1 in. were chosen. The increment of change in throat area between the sizes was adjusted to facilitate uniform flow adjustment with the high-pressure method. With about 5 lb per hr increments, flow ranges to 60 lb per hr can be covered with a 3-nozzle combination, and to a maximum of 1000 lb per hr with a 5-nozzle combination. Fig. 2 shows a complete set of Heat Exchange Institute flow-nozzle standards.

The shape and proportions chosen conformed with best experience and recommendations of the ASME Fluid Meters Research Committee. The nozzle proper has the entrance shape of an ellipse with the proportions shown in Fig. 3. The ASME Power Test Codes approve its use.

All of the nozzles are designed so that they must be mounted in adapter fittings. This arrangement affords a number of desirable features; such as ease of manufacture, elimination of undesirable pipe threads, greater protection for the nozzle proper, and, of most importance, a fixed ratio of nozzle diameter to pipe diameter on the exit side. This feature is a fundamental requirement for low-pressure applications where a downstream pressure tap must be used. Fig. 4 illustrates use of special adapters designed to facilitate testing of steam jets by the high-pressure method. Fig. 5 shows modification of the adapter to include the pressure tap on the downstream side.

To preserve the highly polished surface finish, stainless steel was the preferred material and was actually used on all nozzles except the two large sizes. Shortage of this material, due to war conditions, dictated use of bronze for the ¾- and 1-in. nozzles.

An order was placed with the American Instrument Co to manufacture 24 sets of these flow nozzles in accordance with exacting specifications. These called for accurate reproduction and blending of the ellipse with the cylindrical section, maintenance of uniform throat diameters within extremely close tolerances, highly finished and uniform surface polish, and exact duplication of all sets in terms of throat diameter and flow coefficient.

Nozzle Template Layout

Fig. 3 shows that the orifice flare is formed by one quadrant of an ellipse that must be joined with exact tangency to a cylinder, both of which are proportioned as a function of the diameter. Thus, it was necessary to develop an ellipse for each size of orifice, in which the ratio of these parts was constant but in which the absolute values changed as the diameters changed. As a first step, a template of the exact flare shape was made by drawing the ellipse on thin sheet steel to a scale of 10 to 80 times the finished nozzle size. This was then cut, carefully filed to shape, and polished by hand.

To check template accuracy, the ellipse was plotted to the same scale on cross-section paper, using the classical

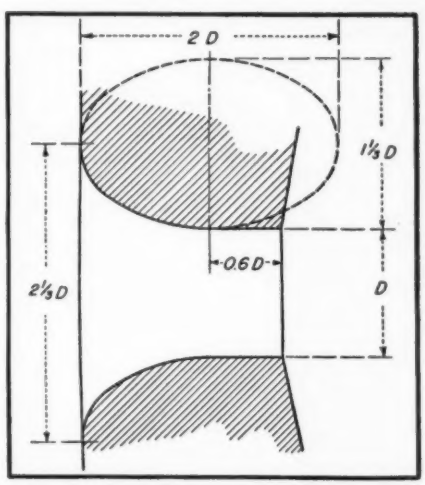


Fig. 3—Proportions of ASME long-radius flow nozzle for HEI standards

ellipse formula for determining the curve. Deviation of template from plotted curve was less than one half the pencil-line width, indicating a high degree of accuracy.

The template was laid on the master table of a Gorton Pantograph engraver with preloaded bearings, and a single-point diamond tool transferred the shape to the flat surface of a single-edge tool-steel cutter. This cutter was then turned in the lathe to the engraved line to produce the desired shape, as shown in Fig. 6.

Nozzle Machining Method

An optical projector did final checking of the forming tool. The template was inserted in the beam of the lantern and projected to twice size on bromide paper. During the process of shaping, each tool was removed from the lathe frequently and checked against the photograph. The high spots were marked and the tool dressed until it conformed exactly to the image of the template.

The straight section of the orifice was produced in the conventional manner by a drill a few thousandths of an inch undersize and reaming to 1 or 2/10,000 in. undersize. By turning and polishing, the pilots of each contour tool were made to fit the reamed holes and insure concentricity of the straight and curved sections of the nozzle. The curved section was produced by feeding the contour tool forward, Fig. 7, until it produced tangency between the curves and the front face of the nozzle on a circle whose diameter was $2\frac{1}{3}$ D, as indicated in Fig. 3.

The finishing reamers were all made to produce holes of a diameter corresponding to the minimum tolerance so that enough stock was left in the holes for good polishing without changing the size above the plus tolerance.

After each orifice was finished up to the point of final polish, it was filled with hot wax and allowed to harden. Each plug was then placed in the beam of the lantern and checked against the template for shape. None was found in which the match was not well within required limits of accuracy.

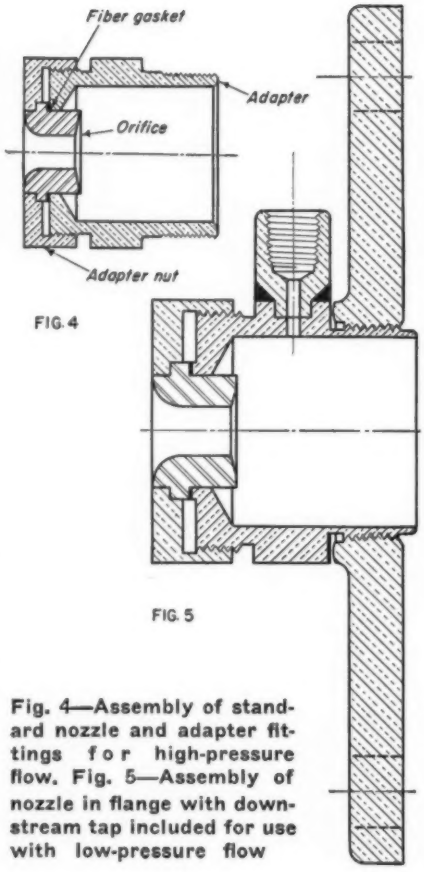


FIG. 4

FIG. 5

Fig. 4—Assembly of standard nozzle and adapter fittings for high-pressure flow. Fig. 5—Assembly of nozzle in flange with downstream tap included for use with low-pressure flow

Gages shown in Fig. 8 were produced for determining the length of the nozzles' straight sections. Plug *A* was made with a diameter about 1/10,000 in. over the diameter of the straight section. Hence it would enter the curved section to a point of tangency with the straight section. A second plug *C* was made to the exact length of the straight section. As the orifice was left longer than required it remained only to face it back until it matched plug *C*. The length of plug *A* minus the height of collar *B* gave the length of the curved section.

After verification of these measurements, there remained a light polishing operation, which required extreme care in handling the nozzle. The entire inner surface was polished and a straight section blended with the curve without removing enough metal to change the size appreciably. This was done with sections of round leather belting, charged with jeweler's rouge applied while the orifice was rotated at high speed. On the smaller sizes pipe cleaners were used in the same manner. After completion of the polishing operation the contour was again checked with wax plugs in the lantern and the diameters were checked with the certified gages.

Checking Nozzle Dimensions

Two specially designed plug gages were made for each diameter of orifice. The diameter of the *no-go* gage corresponded to the maximum tolerance. The *go* gage was long, made with a slight taper on the outer half of its length, and the entering-end diameter corresponded to the minimum tolerance dimension. The National Bureau of Standards certified the dimensions of these gages to five decimal places.

Careful measurements of the finished nozzles with the gages showed a duplication of the diameters, which was within one third of the allowed tolerance for the smaller sizes and one fourth for the larger of the sizes.

The National Bureau of Standards checked all nozzles of the 24 complete sets for diameter with the master gages and ten of the sets selected at random were set aside for calibration.

An article describing the methods of calibrating these nozzles and the results will appear in an early issue of POWER.

FIG. 6

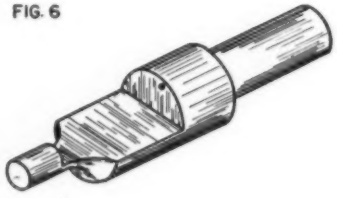


FIG. 7

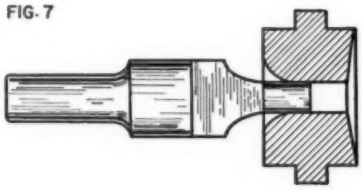


FIG. 8

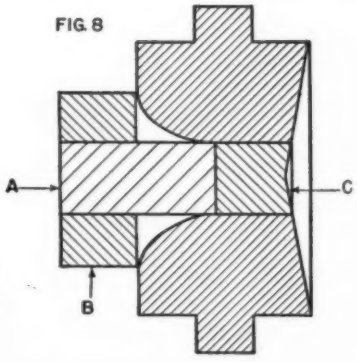


Fig. 6—Entrance-flare forming tool. Fig. 7—Forming-tool pilot insures concentricity of cylinder and entrance flare. Fig. 8—Gages establish length of nozzle's cylinder section and measure the total length of flare

Inspecting Wire Rope Is a Man-Sized Job

It takes years of experience and a full knowledge of the technical properties of rope to know when it is economical to retain a length and still be thoroughly safety minded. Here W E Rossnagel, widely known safety engineer, describes the numerous warning symptoms that point to early rope failure

▶EQUIPMENT INSPECTORS face a difficult problem in deciding when a wire rope has reached the limit of its safe life and must, therefore, be discarded. Naturally, it is poor economy to scrap an expensive hoisting rope before necessary. Likewise it is dangerous (and may also prove more expensive) to continue using the rope beyond a certain stage. To be able to inspect a rope sensibly, learn how it is fabricated, Fig. 1, and where each type serves best. When removing rope from the storeroom make certain that it is the type and size best suited for the service. Quite often this can be ascertained only from office records.

Characteristics of a rope include (1) diameter (2) number of strands, and wires in each strand (3) quality of the steel (4) Warrington or Seale construction (5) regular or Lang lay (6) right or left lay (7) ordinary round or flattened strands (8) hemp or wire strand or independent wire-rope center (9) preformed or non-preformed. The commoner rope types and their recommended uses are listed in Table I.

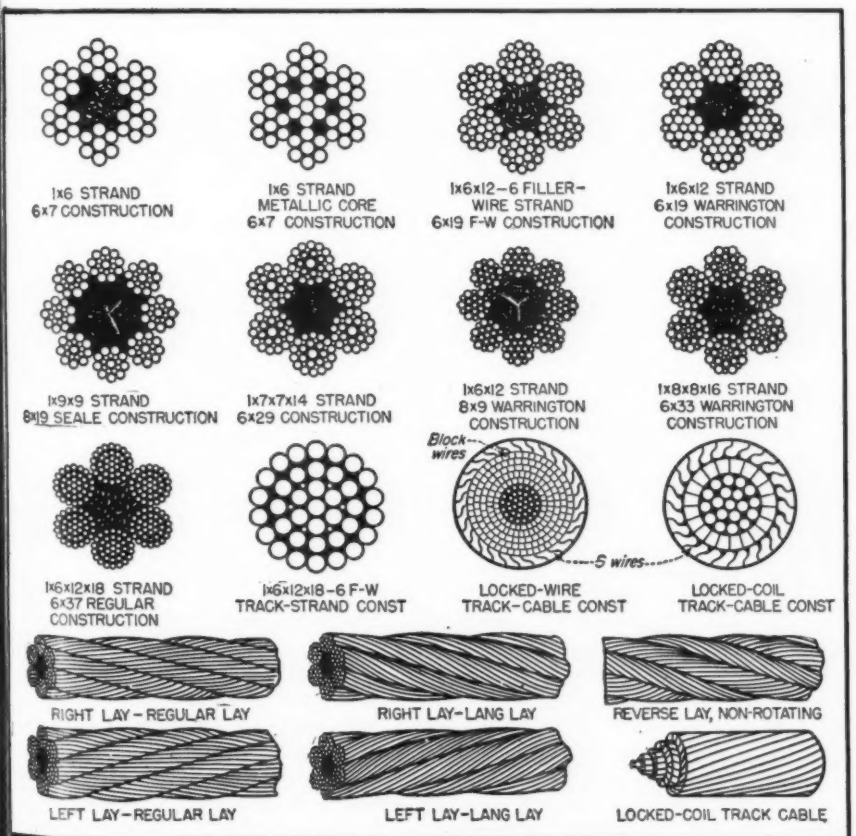


Fig. 1—Construction details of common wire ropes. If you require more than one variety, use an accurate record and tagging system to prevent misuse

The total number of broken wires in all strands within one rope lay (the distance, lengthwise, in which a strand makes one complete turn around the rope) at the worst point is an index of the reduction in strength from breakage. (Exercise extreme care when inspecting preformed rope because broken wires lie flat and are difficult to detect.)

Observe whether several adjacent wires are broken and whether the breaks (1) occur at the point of tangency with the sheave groove, which may indicate metal fatigue, or tangent to adjacent strands, which usually indicates lack of internal lubrication and (2) are about equally distributed among the strands or are mostly located in a few strands. Unequal distribution of breaks all in one strand causes greater loss in over-all strength than when the same number are equally distributed.

The type of wire break may indicate the cause of its failure. For instance: If an individual wire breaks straight across it was probably caused by fatigue. If the wire is necked down at the point of failure the cause was probably overload or excessive stress. A V-shaped break where the two broken ends point towards each other indicates excessive abrasion. Wires broken at an angle indicate excessive torsional stress.

Measure the length of shiny, worn spots on the outside wires, Fig. 2, with a steel scale graduated in one-hundredths of an inch because it is an index of the reduction in area, as well as strength, of the wires and of the rope. Where the personal and property haz-

Table I—Common Rope Types And Recommended Uses

- 6x7 *reg lay:* Guys, highway guard ropes
- 6x7 *Lang lay:* Cableways
- 6x19 *filler wire, reg lay*: General hoisting tackle, buckets, elevators, derricks
- 6x19 *Warrington, reg lay*: General hoisting tackle, shop cranes, hoists
- 6x19 *filler wire, Lang lay*: Shovels
- 8x19 *Seale, reg lay:* Elevators, hoists
- 6x29 *filler wire, reg lay:* Hoists, shop cranes, buckets
- 6x29 *filler wire, Lang lay;* Shovels
- 8x19 *Warrington, reg lay:* Shovels, light-duty hoists
- 6x33 *reg lay:* Shop hoists
- 6x33 *Lang lay:* Shovels
- 6x37 *reg lay:* Shop cranes and hoists
- 6x6x7 *reg lay:* Tiller ropes, control cables, shipper ropes

ard is great, as in elevators, mine hoists and hot-metal cranes, follow a strict rule for condemning a rope. Here is one from the U. S. Bureau of Mines. Condemn a rope if—

Broken wires in one rope lay are:		% wear on outside wires is:
0	but	35
3	and	30
4	and	20
5	and	10
6	and	0

(Wear on outside wires indicates percent reduction in cross-sectional area.)

On the other hand, where the personal and property hazard is not great, for instance, with bucket and skip hoists, unloaders, hand-power cranes and derricks, a more liberal rule, Table II, may be followed in condemning wire rope. On machinery, such as horizontal cable roads, draglines and steam shovels, where no danger ordinarily results from a cable failure, it is sometimes customary although not advisable to keep the rope in service until a strand fails.

Reserve Strength

Reserve strength factor is the ratio of the cross-sectional area of all the inside wires to total rope area. In other words, if all the outside wires fail, the strength of the inner wires should remain as a reserve. Seale constructed ropes have the lowest reserve strength and 37-wire-strand ropes the highest.

Ropes that have been neglected and are badly corroded on the outside may reasonably be assumed to be in a somewhat similar condition inside. However, effect of corrosion is difficult, if not impossible, to estimate. Carefully examine kinked areas, Fig. 3; wear and wire failures occur early at such locations because the load is unequally distributed on the several strands and the rope binds in sheave grooves. Crushed strands should be carefully inspected for the same reasons.

High stranding occurs when one or more strands are forced out of position giving the rope a corkscrew appearance. It produces unequal distribution of stress, excessive wear, and causes premature rope failure. Birdcaging, usually the result of improperly installing the rope, or of inadequate seizing, is quite common in Lang-lay rope. Such a condition is usually the result of improper socketing or clipping.

The pitch of one rope lay of a used rope should not differ materially from that of a new one. Sometimes the portion of the rope that passes over improper sheaves will have its lay increased, the twists accumulating at the rope ends as evidenced by the shortened lay at these points. Lengthening of the lay at a socket is evidence of a weak attachment and is sufficient cause for cutting off rope end and resocketing it.

Pay special attention to the end attachments because the rope is no stronger than its terminal. Where clipped eyes are used, see that Crosby clips are placed so that the U-bolt bears upon the short or dead end of the rope. Space the clips about six rope diameters apart and permit no slack in the short end of the rope between clips. If clips have been improperly placed cut off the crushed portion of the rope before reapplying them.

If the clips have roddles (the corrugated forged parts) bearing upon both the live and dead end of the rope, it is immaterial how they are positioned on the rope. Also, one less clip is required than is recommended for Crosby clips. Clipped eyes with thimbles have an efficiency of about 80%. Apply seizing to the rope end to prevent the strands unlaying at the end clip. An inspector should look for loose clips as well as those that damage the rope.

When installing left-lay rope make certain that left-lay clips are used because right-lay clips on a left-lay rope, or vice versa, cut the strand wires; the sharp ridges between grooves in the clip roddle run crosswise to the strands rather than between and parallel to them as intended. Left-lay clips are not stocked by all dealers.

Use Thimbles

Use a heavy thimble in every eye, whether spliced or clipped; this thimble should not be deformed, broken or displaced. Where spliced eyes are used, learn, if possible, whether an able splicer made them, and note whether at least four tucks have been taken. Cover the projecting strand ends with serving wire tightly wound onto the splice. Spliced eyes with thimbles have efficiencies of 88 to 100%.

Tying wire rope in half-hitches or square knots is prohibited. Provide free rope ends with at least three wire seizings of about ten wraps each, spaced an inch or so apart to hold the strands in proper position.

Carefully inspect a rope where it enters the throat of a socket. If even a single wire is broken, or if corrosion is evident, cut off the bad part and resocket. Accumulated twist in a rope near the socket from continuous operation over improper sheaves also calls for resocketing.

Hoisting ropes on elevators and mine hoists should be resocketed at frequent intervals, varying from monthly to bi-

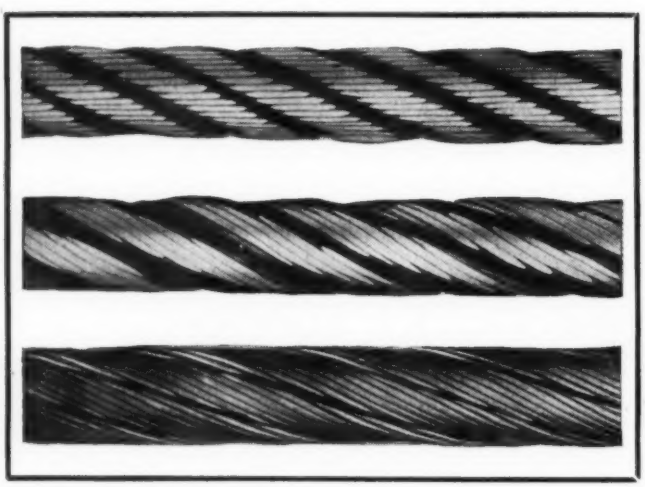


Fig. 2—Length of the shiny worn spots on outside wires is an index of the reduction in area as well as in strength of the individual wires and also the rope proper

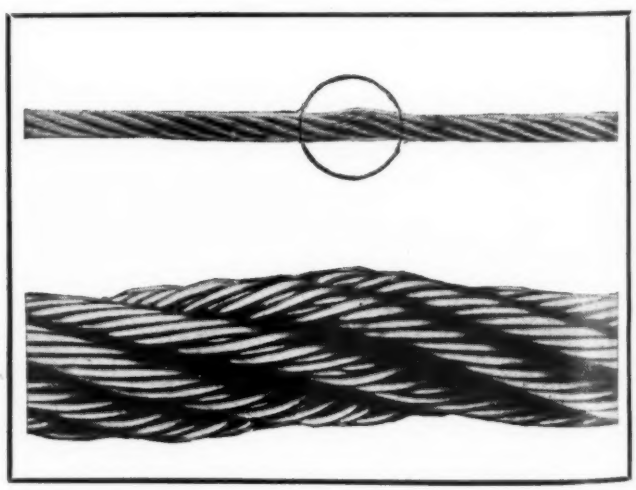


Fig. 3—Kinks cause early failure because the load divides unequally among the several strands and the rope binds in sheave grooves. Examine kinked rope with care

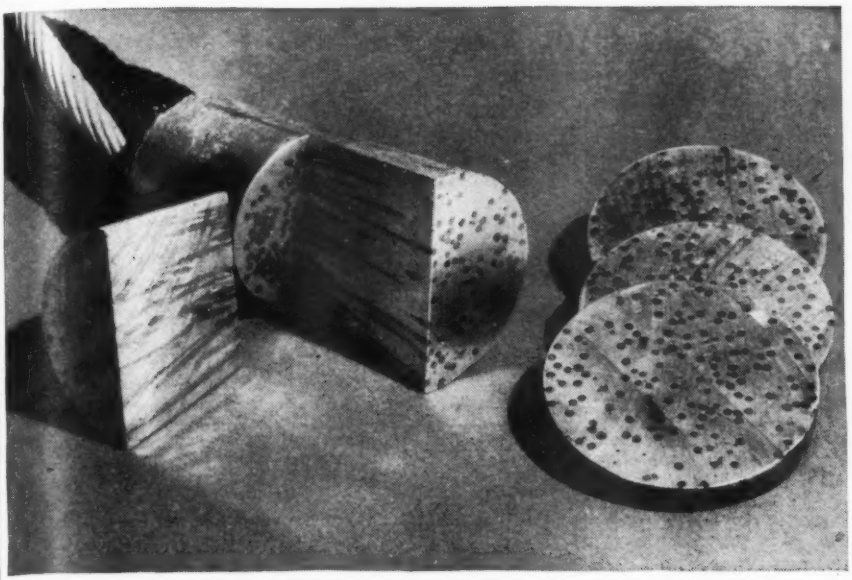


Fig. 4—Quality of workmanship determines strength of a socket. Good wire separation, cleaning and fluxing assure a good bond between wires and zinc

yearly, according to the severity of service. Before resocketing anneal the socket by heating in a wood fire to a cherry red color and then allow it to cool with the ashes. After the sixth annealing, discard the socket. See that the socket neck or throat is rounded to reduce wear and cutting of the rope.

Sockets made with the wires straight and grouted in zinc, Fig. 4, have an efficiency as high as 100%, depending upon the size of the rope and quality of workmanship. Bending the strands backward and grouting in babbitt produces joints having efficiencies as low as 25%. Never use lead for socketing.

Wedge Sockets

Wedge sockets, while not as efficient as some other attachments, are commonly used on boom cranes. The socket must fit the rope and be installed as in Fig. 5. Do not use makeshift wedges. Standard wedge sockets have an efficiency of about 70%.

Where *long* splices are permitted, such as on endless cable roads, overall length of the splice (in feet) should be about 32 times the rope diameter in inches. If properly tucked in, the strand ends are difficult to locate.

New rope on hoists and derricks, where the rope reeves through multiple pulley blocks, stretches and unlays slightly, causing the load block to rotate and the several lengths of rope to twist around themselves. When this happens, detach one end of the hoist rope, whether it is at the load block or boom head, and twist it to remove the turns. Correct for this when installing a new rope by untwisting it a few turns in anticipation of subsequent stretch.

The number of hours per day or week during which the rope is used is an important factor. The inspector should consider how much use and depreciation a rope may be expected to have before next inspection. In other words, consider two ropes in identical conditions and under similar loads. One is used only an hour or so a week and probably will be safe at least until the next inspection, while the other rope used eight hours a day will probably be in a dangerous condition in a much shorter time. Therefore, the much used rope should be condemned while the other may be accepted for further use. A high-speed rope will have a much shorter life, and also life expectancy, than a slow-speed rope, and therefore should be given a more severe inspection.

Consider the number, size and alignment of sheaves and drums, and reverse bends. Note particularly the spacing and size of sheaves causing reverse-bend operation. All ropes operating under such conditions should be condemned at early signs of failure as they are probably badly fatigued. A rope should not under any circumstance be operated on a sheave having a mean diameter less than 16 times the rope diameter (assuming a 6x19 Warrington rope). A ratio of 24:1 is preferred, and 30 to 50:1 is ideal. Where sheaves are not in alignment, excessive wear on the rope can be expected.

Corrugated sheave grooves cause rapid depreciation of a rope. Also, a badly-worn groove made by an old rope pinches and wears a new rope when it is installed. To accommodate a new rope the groove should be about $\frac{1}{16}$ to $\frac{1}{8}$ in. larger than the nominal rope diameter. Test gages made to the following diameters can be used to check grooves:

Rope dia, in.	*Gage dia, in.*
5/16	3/8
3/8	7/16
7/16	1/2
1/2	9/16
9/16	21/32
5/8	23/32
3/4	27/32
1	1 3/32

Investigate acceleration and deceleration rates, the probability of jerks, sudden takeup of slack, and rope whipping because these factors aggravate fatigue of the metal as well as induce excessively high stresses in the rope.

On a hoist or crane that uses an equalizing sheave, especially when the sheave diameter is less than about 16 times the rope diameter, carefully examine the rope section that bears on the sheave. Frequently, broken wires are found at the equalizing sheave although portions of the rope running over other sheaves are in good condition. If more than one layer of rope winds on a drum, look for crushed strands where pinching takes place against the drum flange at the end of rope layers.

Give particular attention to wire-

Table II—Conditions That Condemn Wire Rope

Use	*Conditions*	*6x19 Warrington*	*6x37 Reg*	*8x19 Warrington*	*6x19 Seale*	*Other conditions*
Cranes	Total	18	30	24	..	Wear on outside wires
	Adjacent	4	6	4	..	in excess of 33%
Hoists	Total	24	..	32	..	
	Adjacent	5	..	5	..	
Passenger elevators	Total	12	..	16	8	Wear on outside wires
	Adjacent	4	..	4	3	in excess of 33%
Freight elevators	Total	13	..	18	9	Wear on outside wires
	Adjacent	4	..	4	3	in excess of 33%

Total means the total number of wire breaks in all strands in one rope lay
Adjacent means the number of adjacent wires broken

rope lubrication. Ropes are thoroughly impregnated with lubricant during manufacture, but this oil gradually oozes out during use. Frequent application of proper lubrication during service prevents the hemp core becoming dry. A dry-core rope wears and crushes more quickly than a lubricated one. Also, it absorbs moisture more readily, which results in interior corrosion.

Lubricant must be sufficiently thin to penetrate the center of the strands and of the rope, yet it should be viscous enough not to run off or to be thrown off by rapid movement. Hoisting ropes should be lubricated at least once a month, and more frequently if conditions require.

On traction-drive elevators only a small quantity of very thin oil is used on the ropes so as not to reduce the adhesion between ropes and drum. When rope lubricant becomes dry and flaked, it should be removed with a wire brush and new lubricant applied.

Protect Idle Ropes

When ropes are to be idle outdoors a prolonged time coat them thickly with a heavy protective lubricant. Do not use tar or compounds containing asphalt because these substances must be heated before they can be removed and heat may injure the hemp center.

The weakest part of a rope, like the proverbial chain, determines its overall strength. This weak point may be where (1) rope is badly worn (2) rope has a number of broken wires (3) stresses are unequal in the strands (4) stresses from bending over a sheave are excessive (5) rope is attached to the equipment upon which it is used. For instance, if a ¾-in. plow-steel rope has a safe load of 8240 lb under direct tension, and if bending stress at the sheaves reduces the strength to 75% of this load, there is no need to get concerned over the use of a clipped eye since it has an efficiency of about 80% and is still stronger than that portion of the rope passing over the sheave. Also, the rope itself becomes weaker with wear while the strength of the attachment should remain unchanged.

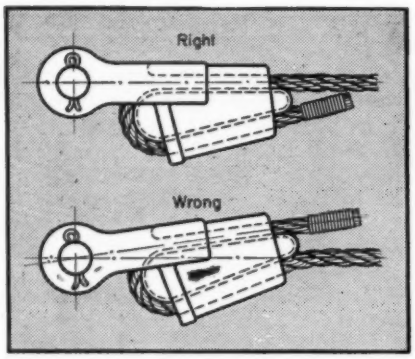


Fig. 5—Install live end of rope opposite the clevis pin in a wedge socket

Always consider the possible consequences resulting from rope failure, especially where men are hoisted, as in elevators or mine cages, or where heavy loads are carried in congested areas above men or valuable machinery.

If a liberal safety factor has been allowed when the rope is new, naturally a greater depreciation may be permitted than if a low initial safety factor were used. This means inspecting every inch of the cable because a spot overlooked may contain the weakest part. These factors are then summed up in relation to the personnel and property hazard and the original safety factor to determine whether the rope is to be accepted or condemned.

Where ropes habitually depreciate rapidly at one end because of the character of the equipment upon which they operate, it is economical to reverse them end for end before they become bad enough to condemn.

Safety engineers recommend that all wire rope issued from company storehouse be identified by a metal tag bearing a serial number which refers to records containing the date issued, rope quality (cast steel, plow steel, etc) and manufacturer. Some organizations use a 1-in. length of aluminum tube, just large enough to slip over one strand of the rope at the seizing, socket or eye splice, with a serial number stamped on it. When this is not desirable, keep only one grade of rope; if several grades are stocked there is no way to differentiate between them once they are removed from the manufacturer's spools. Accidents may result from assuming a rope to be of a higher grade than it actually is.

Table III—Practical Information on Ropes and Chains

BREAKING STRENGTHS, LB PER SQ IN.

	Wire rope (6x19 Warrington)*				Chain	
Diameter in.	Cast steel	Plow steel	Improved plow steel	Manila rope	Forge welded	Electric welded
¼	4200	5000	5800	.....	.....	.....
5/16	6400	7800	9000	.....	.....	6150
⅜	9000	11,000	12,600	1450	.....	13,340
7/16	12,000	14,600	16,800	.....	.....	17,970
½	15,400	18,800	21,600	2450	15,000	22,240
9/16	19,200	23,400	27,000	.....	.....	.....
⅝	23,600	28,800	33,200	4000	23,000	.....
¾	33,600	41,200	47,400	4900	33,000	.....
⅞	45,600	56,000	64,400	7000	43,000	.....
1	59,000	73,000	84,000	8200	56,000	.....
1⅛	74,000	92,000	106,000	11,000	71,000	.....
1¼	92,000	113,000	130,000	12,500	88,000	.....

* Note:—For 6 x 37 construction use 95% of above values. For 8 x 19 construction use 92½% of above values.

FACTORS OF SAFETY $\left(\frac{\text{Breaking strength}}{\text{Safe working load}}\right)$

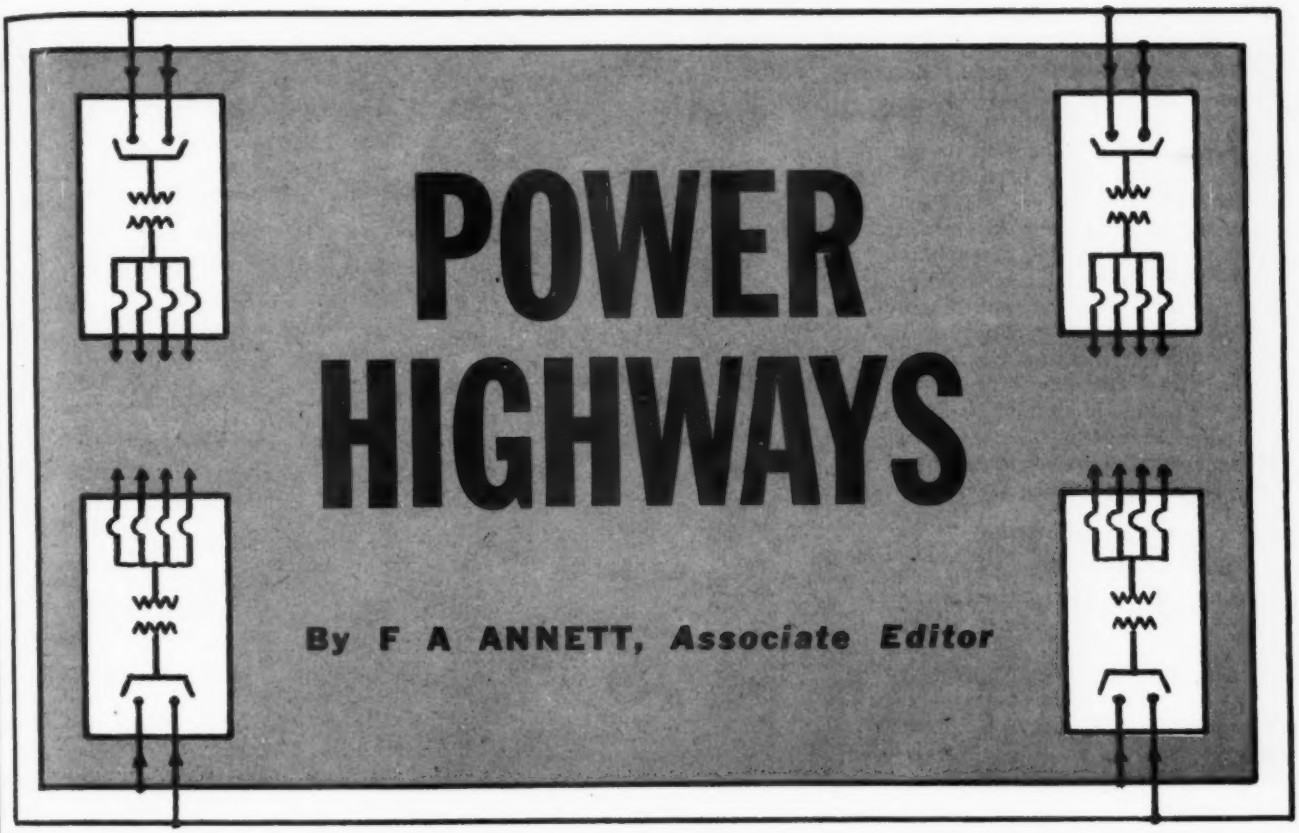
	Low speed	High speed
Wire rope and chain	5	6 to 8
Manila rope	10	25

DISCARDING WIRE ROPES

	6x19 Warrington	6x37	8x19 Warrington	6x19 Seale
Cranes	18 broken wires in 1 rope lay, or 4 adjacent wires broken	30 broken wires in 1 rope lay, or 6 adjacent wires broken	24 broken wires in 1 rope lay, or 4 adjacent wires broken	18 broken wires in 1 rope lay, or 6 adjacent wires broken
Hoists (skip hoists, coal hoists)	24 broken wires in 1 rope lay, or 5 adjacent wires broken		32 broken wires in 1 rope lay, or 5 adjacent wires broken	
Elevators (passenger)	12 broken wires in 1 rope lay, or 4 adjacent wires broken		16 broken wires in 1 rope lay, or 4 adjacent wires broken	8 broken wires in 1 rope lay, or 3 adjacent wires broken

MINIMUM SHEAVE DIAMETERS

	Wire rope (diameter = d)			
	6x19 Warrington	6x37	8x19 Warrington	6x19 Seale
Operating sheaves	24 d	16 d	20 d	28 d
Equalizing sheaves	16 d	14 d	14 d	20 d



POWER HIGHWAYS

By F A ANNETT, *Associate Editor*

The best electric power-distribution system for a given plant pays high dividends on its investment in reliable service, good voltage regulation and reduced operating costs, whereas an inadequate one is a source of trouble and expense. Plant engineers should have these simple facts in mind when installing a new power system or modifying a wartime one to peacetime needs. To assisting them in this job POWER devotes its 55th special section. Here are presented concisely the more important features of electric power-distribution systems for industrial plants, equipment used, how to figure conductor sizes for dc and ac feeders.

WIRE AND CABLE

Even though copper or aluminum bus-bar systems are used extensively for indoor-power distribution, insulated wire and cable still form a major portion of the conductors in these systems. Consequently, this first article in *Power Highways* is devoted to these conductors. Electric wire and cable constructions, insulations, finishes, protective coverings and current-carrying capacities are legion, but the 19 types listed in the table on page 81 are of most general interest for indoor conductors.

This table, from the 1940 edition of the National Electrical Code, lists wires according to type letters. The first, Type R, is the old familiar Code type with so-called Code-grade rubber over a copper conductor. A moisture-resistant flame-retarding fibrous covering is placed over the rubber, Fig. 1 and 2, page 80. This wire is more generally used and in greater quantities than any other but, as the table shows, it is limited to operating temperatures of 122 F or less.

Type RW, next in the table, is the same as Type R except that it has a moisture-resistant rubber insulation, Fig. 3, similar to that on submarine cable. Used for wet locations where lead-covered insulation would otherwise be required, it is good for a maximum temperature of 122 F.

Performance-grade rubber, Type RP, Fig. 4, is suitable for general use at a maximum temperature of 140 F. Chief difference between this insulation and Type R is that the rubber is compounded to operate at 18-F higher temperature.

For higher temperatures than are allowed for Type RP insulation, Type RH can be used up to 167 F, which is the highest temperature permitted for any rubber insulation. This wire is similar to Type R except the difference in quality of its rubber insulation, and a slightly heavier fibrous covering, intended for general use, which is both moisture resistant and flame retardant.

Type RHT, Fig. 6, is a small-diameter building wire with the same quality rubber insulation as Type RH, but available only in sizes 14 to 8, inclusive. Its insulation wall is thinner and requires only one braid, which gives it a smaller diameter than Type RH. It is intended for general use when applied according to Section 3005-d of the Code.

For rewiring existing raceways, where the temperature does not exceed 140 F,

Type RPT, Fig. 7, a small-diameter building wire with performance-grade-rubber insulation may be used. Since it is made in sizes of No. 14 to 10, it requires only a single-braid covering over the insulation. Otherwise, its construction is the same as Type RP.

Next in the table is Type RU, Fig. 8, a thin-walled 90% unmilled grainless rubber insulation for 140-F maximum temperature. This insulation is of such high quality that when applied more than one half as thick as performance-grade rubber it provides proper mechanical and electrical protection to the conductor. Made in sizes of No. 14 to 10 only, with moisture-resistant flame-retardant fibrous covering, it is limited to the rewiring of existing raceways.

Synthetic Insulation

Today synthetic insulating compound is generally considered a war product. However, it was used previously and Type SN, Fig. 9, is an example. This wire has a solid moisture-resistant flame-retardant synthetic compound insulation for a maximum temperature of 140 F.

Because of its high resistance to mechanical abuse, the Code permits its use without a fibrous covering. It has the smallest outside diameter of any of the small-diameter wires and is used for rewiring existing raceways where the temperature does not exceed 140 F. This wire is available in sizes up to No. 0000 compared to No. 10 for Types RPT and RU. The synthetic insulation is a thermoplastic substance recognized not only for rewiring existing raceways, but also for special applications where rubber insulation would not be suitable.

Used chiefly for switchboard rather than building wire, Type SNA, Fig. 10, has a synthetic compound and felted-asbestos insulation covered by flame-retardant cotton braid. This wire, because of its asbestos insulation combination, is recognized for temperatures up to 194 F.

Long recognized by the Code, varnished-cambric wire, Type V, Fig. 11, is widely used, particularly in the larger sizes. It has a varnished-cambric insulation of the same thickness as Type R Code rubber. Over the insulation are placed two moisture-resistant flame-retardant braids for dry locations, or a lead sheath for damp or wet conditions. Varnished-cambric insulation is permitted for temperatures that range up to 185 F.

Asbestos is widely used as insulation for wires either in combination with other insulations or alone. One of these, Type SNA, has been mentioned; several others are included in Fig. 12 to 16. Type AVA, Fig. 12, is an asbestos-

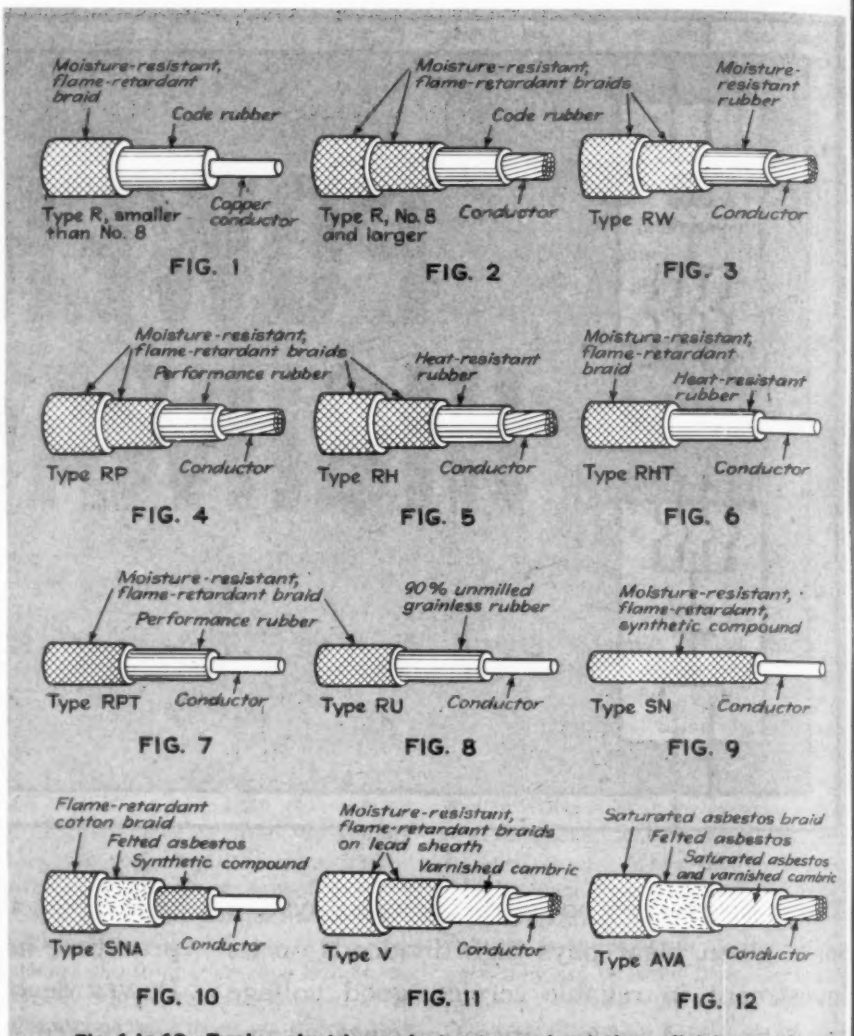


Fig. 1 to 12—Twelve electric-conductor types, insulations, finishes and protective coverings recognized by the 1940 National Electrical Code

varnished-cambric insulated wire, recognized for temperatures up to 230 F. Directly on the conductor is saturated asbestos and varnished-cambric insulation with a felted-asbestos covering protected by saturated asbestos braid. It is used in dry locations only.

Type AVB wire is insulated with alternate layers of saturated asbestos and varnished cambric like Type AVA but has two moisture-resistant flame-retardant braids, Fig. 13. Substitution of an inner cotton braid for the felted-asbestos braid, Fig. 12, reduces the allowable temperature to 194 F. It is also limited to dry locations.

For wet locations in high temperatures, Type AVL has a lead sheath over saturated asbestos and varnished-cambric insulation, the same as on Type AVA.

Type A wire has solid asbestos insulation good for temperatures up to 392 F. It consists of a copper conductor with felted-asbestos insulation good for 300 v with or without an outer impregnated asbestos braid, Fig. 15. Being susceptible to moisture it is limited to such applications as equipment leads in dry locations and is not permitted for general conduit service.

Type AI wire, Fig. 16, has felted-asbestos insulation impregnated with moisture-resistant compound with or without moisture-resistant impregnated braid. Without the braid this wire is limited to 300 v or less, the same as Type A, but with a braid it is good for 600 v. Because of temperature limitations of the impregnating materials, Type AI insulation is restricted to maximum operating temperature of 257 F.

Oil-impregnated paper insulation under a lead sheath, Fig. 17, is used on cables for all voltages, mostly in the public-utility field rather than in installations coming within the jurisdiction of National Electrical Code. It can be used, however, for service-entrance connections, generally where the cable is an extension of an underground system, and for temperature of 185 F and less.

Type SB, Fig. 18, with slow-burning insulation, is the old familiar type used extensively in open wiring run on in-

TYPES OF CONDUCTOR INSULATION FOR 600 VOLTS RECOGNIZED IN 1940 EDITION OF THE NATIONAL ELECTRICAL CODE

TRADE NAME	TYPE NAME	MAXIMUM OPERATING TEMPERATURE	INSULATION	THICKNESS OF INSULATION	OUTER COVERING	USE
Code	R	50 C (122 F)	Code-grade rubber	14–10 . . . . . 3/64 8–2 . . . . . 4/64 1–4/0 . . . . . 5/64 250–500 . . . . . 6/64 501–1000 . . . . . 7/64 Over 1000 . . . . . 8/64	Moisture-resistant flame-retardant fibrous covering	General use
Moisture resistant	RW	50 C (122 F)	Moisture-resistant rubber	Same as Type R	Moisture-resistant flame-retardant fibrous covering	General use or in wet locations. See Section 3035
Performance	RP	60 C (140 F)	Performance-grade rubber	Same as Type R	Moisture-resistant flame-retardant fibrous covering	General use
Heat resistant	RH	75 C (167 F)	Heat-resistant-grade rubber	Same as Type R	Moisture-resistant flame-retardant fibrous covering	General use
Small-diameter building wire (heat-resistant)	RHT	75 C (167 F)	Heat-resistant-grade rubber	14–10 . . . . . 2/64 8 . . . . . 3/64	Moisture-resistant flame-retardant fibrous covering	General use See 3005-d
Small-diameter building wire (performance)	RPT	60 C (140 F)	Performance-grade rubber	14–10 . . . . . 2/64	Moisture-resistant flame-retardant fibrous covering	Rewiring existing raceways see 3005-e
Type RU wire	RU	60 C (140 F)	90 percent unmilled grainless rubber	14–10 . . . . . 18 mils	Moisture-resistant flame-retardant fibrous covering	Rewiring existing raceways see 3005-e
Solid synthetic	SN	60 C (140 F)	Solid flame-retardant moisture-resistant synthetic-compound	14–10 . . . . . 2/64 8 . . . . . 3/64 6–2 . . . . . 4/64 1–4 0 . . . . . 5/64	None	Rewiring existing raceways see 3005-e
Asbestos synthetic	SNA	90 C (194 F)	Synthetic and felted asbestos	14–8 . . . . . . Synthetic . . . . . 20 mils Asbestos . . . . . 20 mils	Cotton braid thickness, 20 mils	Switchboard wiring
Varnished cambric	V	85 C (185 F)	Varnished cambric	Same as Type R except 8 . . . . . 3/64	Fibrous covering or lead sheath	Dry locations only, unless lead sheathed. Smaller than No. 6 by special permission.
Asbestos varnished cambric	AVA	110 C (230 F)	Impregnated asbestos and varnished cambric	14–8 Sol . . . . . 45 mils 6–2 Sol . . . . . 65 mils 1–4/0 Sol . . . . 75 mils 14–2 Str . . . . . 60 mils 1–4 0 Str . . . . 80 mils 250–1000 Str. . 110 mils	Asbestos braid	General use dry locations
Asbestos varnished cambric	AVB	90 C (194 F)	Same as Type AVA	14–8 Sol . . . . . 50 mils 6–4/0 Sol . . . . 80 mils 14–2 Str . . . . . 60 mils 1–4/0 Str. . . . . 80 mils 250–1000 Str. . 110 mils	Flame-retardant cotton braid	General use dry locations
Asbestos varnished cambric	AVL	110 C (230 F)	Same as Type AVA	14–2 . . . . . 75 mils 1–4/0 . . . . . 80 mils 250–1000 . . . . 110 mils	Lead sheath	General use wet locations
Asbestos	A	200 C (392 F)	Felted asbestos	14–8 . . . . . 40 mils 6–2 . . . . . 60 mils 1–4/0 . . . . . 90 mils 250–1000 . . . . 120 mils	With or without asbestos braid	Dry locations only. Not for general conduit installation. In raceways, only as leads to or within apparatus. If without braid or moisture-resistant treatment, limited to 300 v
Impregnated asbestos	AI	125 C (257 F)	Impregnated felted asbestos	Same as Type A	With or without impregnated asbestos braid	
Paper		85 C (185 F)	Paper		Lead-sheath	As permitted by 2304-b, or by special permission
Slow burning	SB	90 C (194 F)	3 braids, impregnated, fire-retardant thread	Same as Type V	Outer cover finished smooth and hard	For use only in dry locations where the room temperature exceeds 85 C (185 F)
Slow-burning weatherproof	SBW	90 C (194 F)	2 layers impregnated cotton thread	Same as Type V	Outer fire-retardant coating	For use only in dry locations where the room temperature exceeds 85 C (185 F)
Weatherproof	WP	80 C (176 F)	At least three cotton braids impregnated	14–12 . . . . . 3/64 10–2 . . . . . 4/64 1–4/0 . . . . . 5/64 225–500 . . . . . 6/64 525–950 . . . . . 7/64 1000 and over 8/64		May be used for interior wiring only by special permission

sulators in mill-type buildings. It has three braids impregnated with a fire-retardant compound and has a maximum operating temperature of 194 F. The Code does not permit its use in conduit, and for open wiring on insulators it is restricted to dry locations, for 600 v or less.

Also for dry places and voltages of 600 or less, Type SBW, Fig. 19, is a slow-burning weatherproof wire. It is similar to Type SB except that its inner braid is treated with moisture-resistant compound.

Weatherproof wire, Type WP, Fig. 20, may be used inside buildings by permission of the authorities who have jurisdiction. Its chief use is for outside applications on pole insulators. Covered with at least three impregnated weather-resistant cotton braids, or their equivalent, this type is good for 176 F.

Multiple—Conductor Cables

Many forms of multiple cable are used, duplex being the most familiar. Duplex conductors, Fig. 21, are arranged flat under one sheath. They are insulated very much as single rubber-insulated wires. A weatherproof braid is placed over the rubber insulation and the two conductors are covered with another braid, which is treated and finished with a moisture-resistant fire-retardant compound.

When three or more insulated conductors are grouped in a cable, a treated jute filler is applied to form a true circle, Fig. 22. In this metalclad 600-v industrial power cable each of the three conductors has varnished-cambric insulation covered with colored tape for identification. A layer of rubber-filled tape binds the three conductors and their jute fillers into a circular cable. Over the tape flame-retardant moisture-resistant braid forms a foundation for the galvanized-steel interlocked armor. For 5000 v, a belt of varnished cambric is placed over the conductors and their jute filler before applying the rubber-filled tape. This cable is designed for use where conductors would otherwise be installed in solid conduit.

Many single- and multiple-cables are made for specific purposes. For example, Fig. 23 shows a 2-conductor cable used on runout reels. The conductors are extra flexible, stranded, rubber insulated. A moisture-resistant fire-retardant braid is placed over the rubber on each conductor. Then the two conductors are bound together under another braid, over which is placed a seine-twine braid, treated with moisture-resistant flame-retardant compound.

A concentric construction, Fig. 24, insulated and protected as shown, gives a round twin-conductor cable. Rubber insulation is placed over the inner conductor and covered with a layer of rubber-filled tape over which is the second conductor. This conductor is insulated with rubber, then cotton braid treated with weather-resistant compound and seine-twine braid, similarly treated.

Cables buried directly in the ground must withstand moisture, acids, alkalies, etc. The one in Fig. 25 gives a general idea of the construction of the various types for this purpose. Conductors are solid or stranded annealed copper, high grade, rubber insulated.

For vertical-bore holes into mines and for high-voltage risers in skyscraper buildings, cables have steel-wire armor. At the top end of the cable the armor connects to a clamping device resting on the top end of the bore hole or conduit. When the cable is installed in buildings, a lead sheath is generally omitted.

A multitude of other wires, cables and insulations are available for standard and special applications. If your electrical distributor does not have the conductors that you need, ask the insulated-wire-and-cable manufacturers.

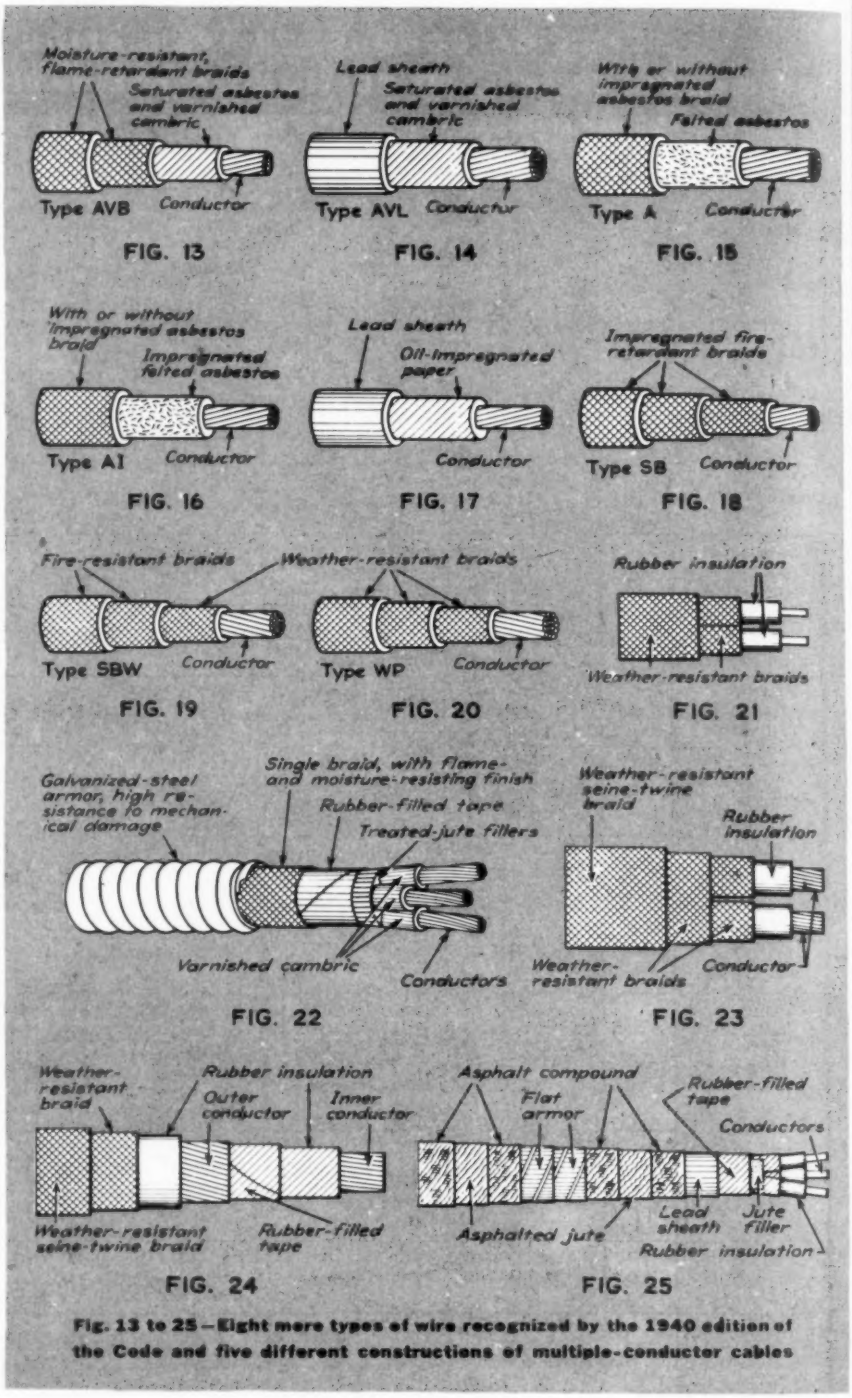


Fig. 13 to 25—Eight more types of wire recognized by the 1940 edition of the Code and five different constructions of multiple-conductor cables

POWER-CENTER UNITS

Modern practice tends toward distributing power through industrial plants at 2,300 to 15,000 v to strategically selected load centers. There it is stepped down and distributed at 600 v, or less, through secondary substations, called power-center units or load-center-unit substations.

These substations combine in a single assembly a high-voltage switching device, a step-down transformer, and low-voltage switching and protective equipment. The diagram shows one of the simplest arrangements of such a unit. Here the high-voltage incoming-line switch is oil filled, hand operated, and mounted on the transformer. Intended to break only the magnetizing current of the transformer, it is interlocked with the low-voltage main breaker so that it cannot be closed or opened unless this breaker is open.

Busbars extend from the transformer's secondary terminals through the main circuit breaker to the feeder breakers. From them, inclosed busbars run out over the plant's working aisles. The breakers, of dead-front thermal-overload-trip design, connect to the vertical busbars by plug-in connections. Other power-center-unit substations have more extensive equipment.

Standard ratings of transformers for unit substations range from 100 to 2000 kva. They are 3-phase units: either (1) oil (2) noninflammable insulating-liquid filled or (3) air cooled, and are usually delta connected on the primary with a Y-connected secondary to provide 4-wire 3-phase when required. Incoming voltage of 2300 to 13,800 is stepped down to 550, 440, 220 or 120-and-208.

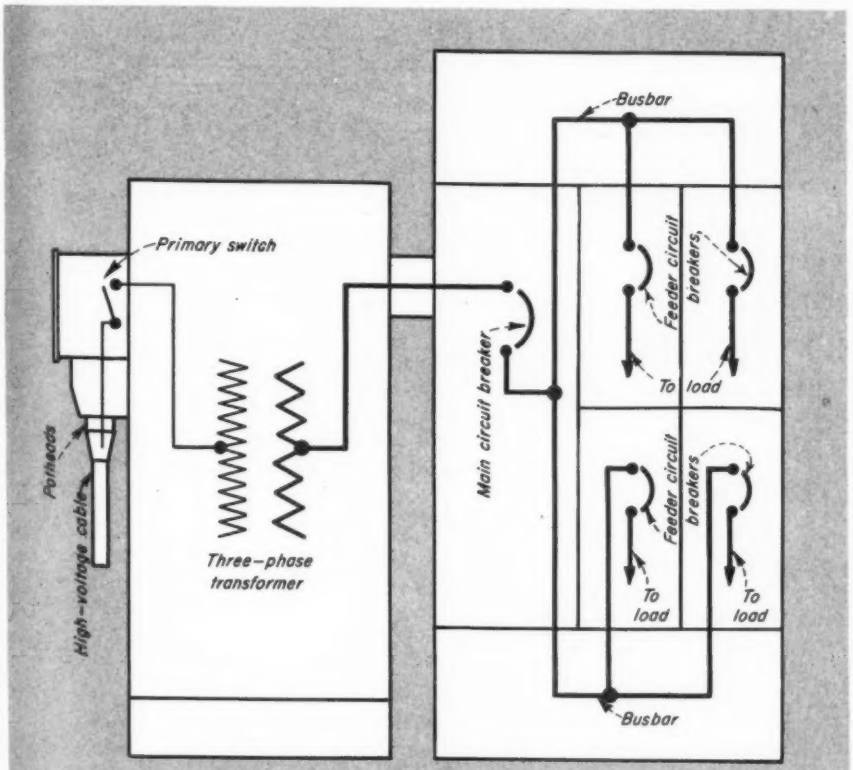
For 120-and-208 or 220 v, standard units up to 1000 kva are available, and up to 2000 kva for 440 and 550 secondary volts. Larger units can be had where the load requires them, but it is generally more economical to install two or more smaller units located more conveniently to the load than a single large one.

Small power-center units are more expensive because small equipment inherently costs more per kva than large. On the other hand, large power-center units become increasingly expensive because of the larger switchgear required to interrupt the heavy short-circuit currents associated with large transformers. As might be expected, the most economical power-center unit is medium sized. For 500-v secondaries, units rated 600, 750 and 1000 kva are the most economical. Power-center units for 220 or 120-and-208 v are more expensive than for 500 v because of increased cable and low-voltage-switchgear cost. This reduces the most economical transformer size to 300 to 600 kva for these units.

Secondary switchgear for the low-voltage distribution circuits is of the metal-inclosed drawout type with easily removable air-break circuit breakers having interrupting ratings of 15,000 to 100,000 amp, as required. Easily removable breakers provide safe and speedy inspection and maintenance. Mechanical interlocks prevent withdrawal or insertion of the circuit breakers unless they are open. Meters and relays may also be of the withdrawal type permitting easy testing and calibrating.

Switch-and-fuse combinations of different designs are also used as protective devices on power-center units, which may include a network protector. The latter is a circuit breaker tripped by a relay on power reversal caused by a fault in the transformer or primary feeder supplying the transformer.

It has not been definitely settled which primary voltage is most economical for an industrial plant's electrical-distribution system. Voltages of 2300 to 15,000 are used, but recent studies indicate that 4160 v generally are more economical than 2400 when over-all electrical costs are considered, particularly for medium-sized plants.



Power-center unit combines in a single assembly a high-voltage switching device, a transformer, low-voltage switching and protective equipment

Unit-Substation Advantages

Power-center-unit distribution has many advantages over the older system of distributing all power from a single unit. Except in small plants installed cost is lowered with increased reliability. Because power-center units are comparatively small they can be readily added to the power system where needed without extensive planning or load forecasting. These units are factory designed, built and assembled ready for operating conditions.

Because unit substations are located at load center, length of low-voltage connections to motors and other loads are shorter than with the older system. These shorter runs reduce voltage and power losses, which results in improved motor performance. When transformers are the dry or the noninflammable liquid-filled type they may be installed at the most convenient location in the load area without a vault.

The article on page 86 indicates how power-center-unit substations are used in electric power-distribution systems.

WIREWAYS AND BUSWAYS

Electric power-distribution-system design must take into account safety, reliability, voltage drop, adaptability to changes in power needs, installation cost, appearance and other considerations. To meet these requirements in various degrees several distribution systems are available: open wiring, usually run overhead or on side walls; wiring run in conduit overhead or on side walls, or laid in floors; underfloor ducts run to convenient locations in load areas; cellular steel floors; wireway systems usually run overhead; and inclosed busbars for use with or without plug-in branch-circuit devices.

Earliest electric power-distribution system used open wiring run overhead or on side walls through load centers. Taps were taken off these conductors at convenient points through protective and switching devices to individual loads, or to distribution panels to supply several circuits. Crude as this system may appear judged by modern standards it contained many of the essential features of a modern busway.

Conductors for open-wiring systems usually have slow-burning insulation and with solderless connectors, taps can be made or disconnected with little delay. Cost of such an installation is comparatively low, and for a given load and weight of copper its voltage drop is comparable to that of a busbar system. However, no matter how carefully the installation is made, this system is unsightly and generally grows worse with time. Also, the conductors have no mechanical protection other than their insulation, which being exposed to moisture, dirt and fumes may deteriorate with age until it becomes a personnel and property hazard.

Wires in Solid-Metal Conduit

Running wires in solid metal conduit protects them against mechanical injury and eliminates much of the property and personnel hazard associated with open wiring. In large systems, conduits require considerable space and lack the flexibility of open wiring. Branch circuits can be connected into them at junction boxes only or at distribution panels.

For rigid conduit, fittings have been developed that permit its installation under practically every condition and give its conductors a high degree of protection. Because of the close arrangement of conductors in conduit they have a low-reactance drop. What has been said about rigid conduit applies to interlocked armor cable except that the latter is more easily installed.

Square metal wireways combine the mechanical protection of conduit with the flexibility of open wiring. Made of heavy sheet metal, 4x4 in. in cross-section, wireways can contain the wires of several circuits. The sections, which are up to 5 ft long, have hinged spring-latched covers, Fig. 2, for easy access to the wires and cables at all points throughout the system. These access covers permit tapping, splicing, rerouting, inspection, installation of additional wires, and other changes without disturbing existing circuits.

The wireway sections are rigidly joined together by clamp-type couplings so that the installation forms a continuous system. Standard fittings, including elbows, tees, crosses, pull boxes and hangers, permit a neat, workmanlike installation in any industrial building construction.

Fig. 1 gives a general idea of how a wireway is installed. Here it runs from a main switchboard out over the work area where a vertical connection goes down to a power panel to supply several motors or other circuits. Beyond this connection circuits are taken off in conduit for various purposes. From a crossover connection, conductors run to a secondary wireway to supply circuits in another work area. For extensions from wireways, the National Electrical Code permits armored cable, flexible and rigid metal conduit, metallic tubing and metal raceways.

NE Code Requirements

This material is approved for installation of feeders, branch circuits, control and signal wiring not exceeding 600 v. Code requirements are:

1. Wires carrying different voltages or having different current characteristics, such as ac and dc, may not be put in the same wireway unless suitable barriers are installed.

2. Wireways may not be installed where they would be subject to mechanical injury or corrosive vapors, in damp locations, hoistways, hazardous locations or storage-battery rooms.

3. Conductors larger than 500,000 cm may not be installed in wireways.

4. Splices and taps made by approved methods may not fill more than 75% of the wireway's cross-sectional area.

5. Not more than 30 wires or cables are permitted unless they are signaling circuits or control wires between a motor and its starter, which are used only for starting duty.

6. Conductors cannot occupy more

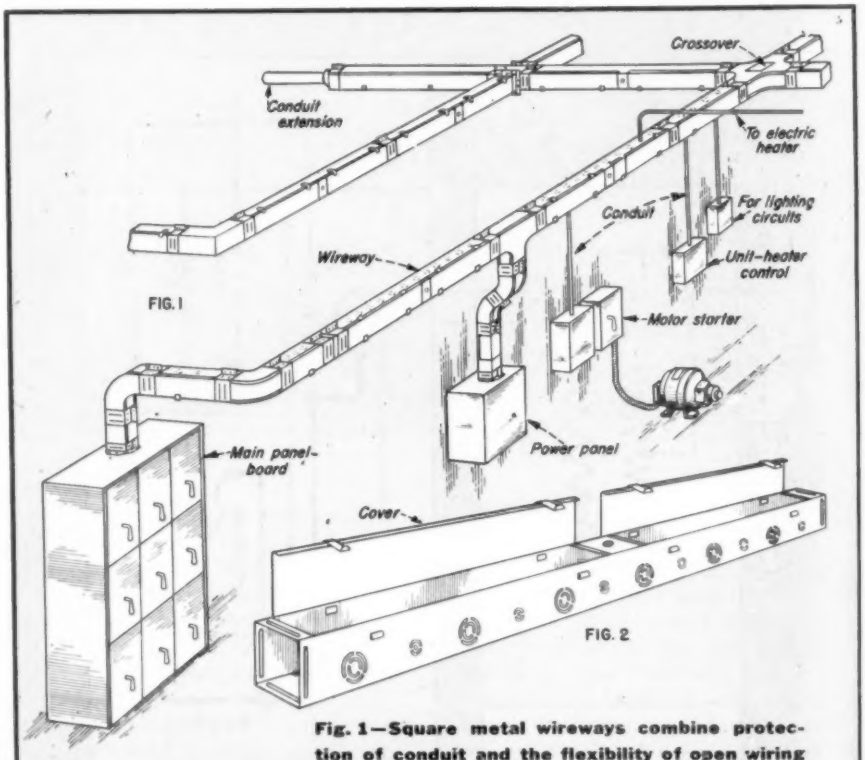


Fig. 1—Square metal wireways combine protection of conduit and the flexibility of open wiring

Fig. 2—Constructed of heavy sheet metal, 4x4 in. in cross-section, wireways are in standard sections up to 5 ft long with spring-latched covers

than 20% of the free cross-sectional area of a wireway. That is, the total cross-sectional area of the wires and their insulation cannot exceed 3.2 sq in. For example, a No. 0 rubber-covered type R, RP, RH or RW conductor has a cross-sectional area of 0.31 sq in. Therefore, 3.2 ÷ 0.31 = 10 of these wires would be permitted in a wireway.

Busbars Serve as Feeders

In one plant, over 30 years ago, to eliminate the multiplicity of conductors required to distribute power from the main switchboard, busbars were extended out through the plant. On each floor or in each department connections were made from these busbars to a distribution board from which ran local power and light circuits.

Such a busbar system had several advantages: As mentioned, it eliminated the many conductors used in open-wiring and conduit systems, and thus greatly simplified distribution. The main switchboard was also simplified because switches and circuit protection were eliminated for a large number of distribution circuits. Since the total load is on one set of conductors full advantage can be taken of the load's diversity factor. Where separate feeders supply different loads, some may be overloaded while others are underloaded. This condition cannot develop with a busbar system because all loads are on it and maximum use is made of available copper.

Extending the busbars to distribution switchboards on each floor or in each department solved only half the problem. Circuits for individual motors or for power and lighting panels had to run in open wiring or in conduit. Such systems in large plants are complicated and lack the flexibility to accommodate changes readily. To attain this end many distribution systems consist of an inclosed busbar system that extends from the generator switchboard or unit substations out in the plant over each production area.

Inclosed busbars, sometimes called busways or busducts, consist of bare or insulated conductors supported on insulators in metal inclosures. Busways are available in two general designs: feeder and plug-in busways.

Feeder busways connect a power source, such as power-plant busbars or transformer banks, with the distribution center. They may also connect to plug-in busways without going through a distributing center.

Designed for current capacities from 250 to 4000 amp for voltages up to 600, feeder busways are made in standard 10-ft lengths, inclosed without provision for branch-circuit connections. The inclosure may be ventilated, or unventilated. The busbars may be supported flat in their inclosure or on edge.

Plug-in busways are run from feeder-busways or distribution centers out over each work area. Their inclosures and buses are arranged for plug-in connections every 24 in., Fig. 4, to accommodate almost any machine arrangement. Standard capacities range from 250 to 600 amp at 600 v maximum, and are designed to have a drop of about 3 v per 100 ft at full rated load. Practically the same voltage drop applies to feeder busways.

Fig. 3 gives a general idea of a simple inclosed busway system. Here transformer secondaries connect through an inclosed circuit breaker to the plug-in busway system, which runs out over the production area. Plug-in connections are made into the busway for each machine. From the connections, circuits generally run in conduit to a convenient safety switch and the machine's motor controller. The motor or motors for each machine are on a separate circuit run from the busway.

Flexibility of Busways

If a machine must be moved this is conveniently done without interfering with any other power circuits. The plug-in disconnect is opened and taken down with its conduit line and moved to the new location. The opening in the bus inclosure at the old location is closed with the plate removed for the bus connection in the new position.

To insure correct rotation of polyphase motors when plug-in disconnects are moved from one location to another, the plugs are polarized so that they will engage in only one position on the housing of the inclosed busbars. This system provides all the flexibility of an open wiring system where a branch circuit can be tapped off almost anywhere, plus the safety and reliability of a conduit system.

Feeder and plug-in busways are made in 10-ft standard lengths with fittings such as elbows, crossovers, tees, cable tap boxes, expansion joints, switchboard flange connections, bus plug-in fittings, with or without circuit protection, for making an installation under practically any conditions.

A third type of inclosed busway, a trolley busway, provides mobile power for small power hoists, portable hand tools, etc. In this, a trolley contactor runs on the busbars in the inclosure. Several of these trolleys may run on the same bus each supplying a separate tool, and they can move from one location to another with the tool, as working conditions require.

The distribution-wiring systems considered are the ones most commonly used. Space does not permit describing the under-floor duct, cellular steel floor and some other systems.

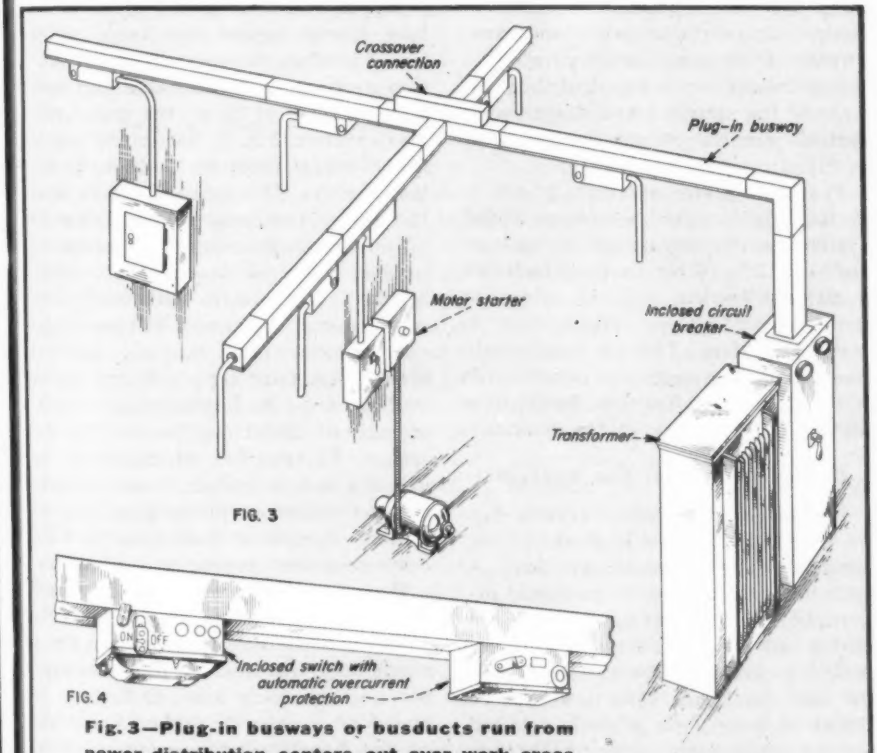


Fig. 3—Plug-in busways or busducts run from power-distribution centers out over work areas

Fig. 4—Plug-in busways or busducts are arranged for plug-in connections every 24 in. to accommodate any arrangement of production machines

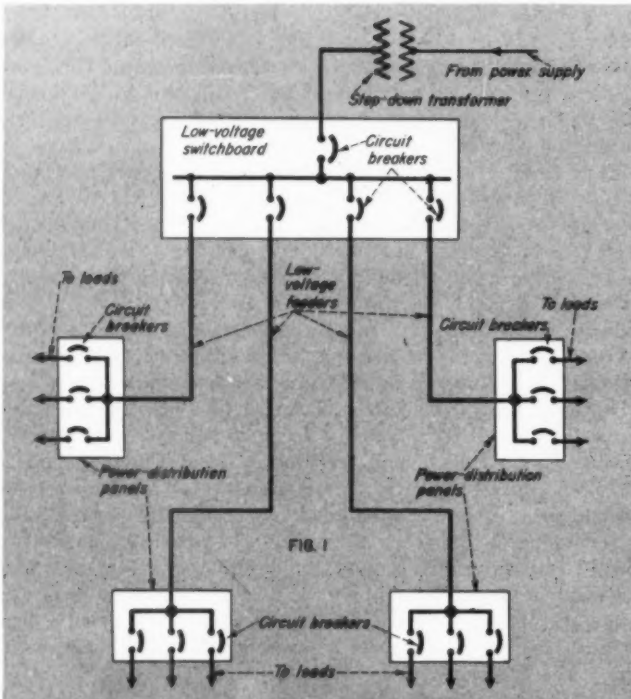


Fig. 1 — Low-voltage radial-distribution system supplied from a single power source connected to a switchboard

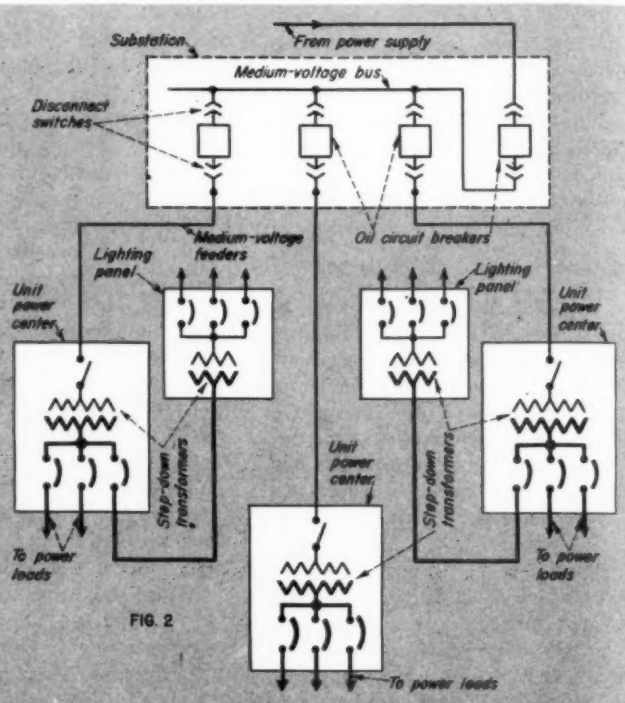


Fig. 2 — Medium-voltage distribution system with radial feeders and step-down-transformer unit power centers

DISTRIBUTION SYSTEMS

To meet the requirements of power supply, plant size, power load, load distribution, reliability and flexibility, installation cost and voltage regulation, several industrial-plant electric power-distribution systems have been developed. These divide into seven general classes: (1) simple low-voltage or medium-voltage radial (2) medium-voltage radial with primary-loop feeders (3) banked-secondary radial (4) primary-selective radial (5) secondary-selective radial (6) simple network (7) primary-selective network.

Oldest and simplest of these systems is the low-voltage radial. It consists of a low-voltage power supply connected to busbars on a switchboard from which feeders run to distribution panels at load centers, Fig. 1. Power may be supplied from a transformer to the busbars, as in the figure, or be generated at low-voltage dc or ac.

One or more feeders run from the low-voltage busbars to distribution panels at load centers. From these panels feeders radiate to individual loads such as motors, lights, heaters, etc. A large individual motor or furnace would normally be supplied by a feeder directly from the main busbars without going through a distribution panel. When the power supply is ac, lighting loads may be supplied from feeders at power voltage, run to step-down transformers at lighting-circuit panels. No matter how power is supplied the principle of the simple low-voltage-radial system remains essentially the same as Fig. 1.

For small plants operating at 600 v, or less, the simple low-voltage-radial system has the advantage of low cost and simplicity. When properly installed additional feeders may be added at normal cost without interference to existing feeders. This is particularly true of modern sectional panelboards with space for adding new distribution sections at either end of the assembly.

Disadvantages of the System

The low-voltage-radial system has the disadvantage that if power to the main bus fails all feeders are dead. A fault in a feeder properly protected interrupts power to load supplied by that feeder only. Voltage at the different panels varies with feeder length and the load on them. This need not be serious if feeders are properly selected for the conditions under which they operate. To carry the same load and have equal voltage at load centers, long feeders must have more cross-section than shorter ones.

As plant size increases, copper cost in long heavy feeders and large power losses combine to make other distribution systems more desirable and economical. One of these, the radial-primary system, Fig. 2, distributes at primary voltage (2300 to 15,000 v) to the load centers. This system, widely used in larger plants, may be installed with oil circuit breakers on each feeder, as in Fig. 2, or without feeder circuit breakers. The system with feeder circuit breakers costs more but has higher reliability than the one without breakers. A fault on a primary feeder in Fig. 2 trips the breaker on that feeder without disturbing the rest of the system. To take full advantage of the primary-radial system, power should be transmitted at primary voltage to centers of greatest load density. This holds secondary copper to a minimum.

Because of the number of small transformers required in Fig. 2, their capacity and cost is higher than for a single large transformer, Fig. 1, to supply a comparable load. Difference in transformer capacity and cost depends on the diversity between load centers. The higher the diversity factor the greater the difference in transformer costs for the two systems.

Transformer costs are also influenced

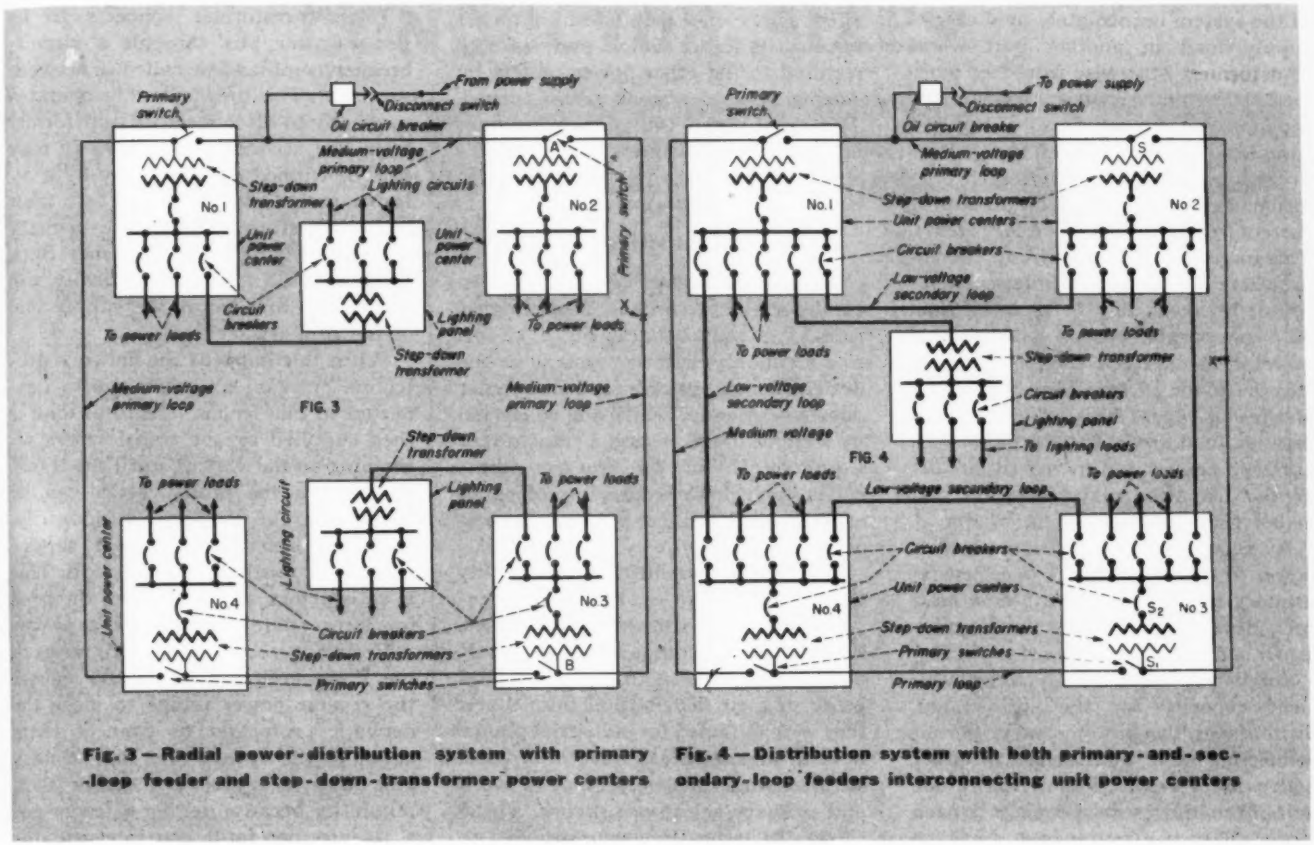


Fig. 3 — Radial power-distribution system with primary-loop feeder and step-down-transformer power centers

Fig. 4 — Distribution system with both primary-and-secondary-loop feeders interconnecting unit power centers

by the amount of reserve transformer capacity that must be provided for future load growth. Except for small plants, the large copper saving makes the primary-radial system lowest in cost of installation in spite of the increase in cost of the transformers.

Primary-Radial System

To insure greater reliability than with a primary-radial system the radial system with primary loop is often used. This system eliminates the substation and its oil circuit breakers, Fig. 2. Primaries of all power-center transformers tie into a sectionalized primary loop. To take full advantage of the system the loop feeders must be large enough to transmit total power load in either direction from the incoming feeder. Where 2300 v is common on the radial system, Fig. 2, a higher voltage, such as 4160 or 6600, should generally be used on the primary loop, Fig. 3, because loop feeders must have more capacity than the radial. At each power-center transformer an automatic oil circuit breaker or a load-break switch permits disconnecting from the system any section of the loop and its associated transformer.

For example, a fault at *X* can be isolated from the rest of the system by opening switches *A* and *B*. This interrupts service to power center No. 3, but the faulty circuit can be disconnected at this center and the load picked up by closing switch *B*. Power is then fed to No. 3 through No. 1 and 4 power-center switches. Faults in a power-center transformer or on its busbars only interrupt the power supply to the load they serve, as in the radial system with primary feeders.

From the power centers of primary-loop system, Fig. 3, circuits for power and light run as in Fig. 2, but cost less because the high-voltage switchgear has been eliminated except on the incoming circuit or circuits. This has lowest installation cost of all the radial systems and, properly designed, gives good voltage regulation.

Primary-loop-radial systems are also installed in arrangements that differ from the simple design of Fig. 3. They may have automatic circuit breakers or load-break switches on either side of the transformer connection to the loop. These switches permit quick isolation of the faulty loop-section feeder and restoration of service to the power center involved.

For large plants requiring greater reliability than with the systems described, a primary loop with banked secondary, Fig. 4, or a modification, may be used. In this system the transformers connect to a primary loop as in Fig. 3, and a secondary loop ties all power-center busbars together. The latter permits feeding power from one load center to another, thus increasing the system's reliability. The primary loop serves the same purpose and is connected as in Fig. 3.

Normally all primary-and-secondary-loop switches are closed to form a single network and power is supplied from each transformer to its power center. If a fault occurs on a loop feeder or in a transformer it interrupts service by opening the transformer breaker, but can be cleared quickly.

Assume a primary-loop fault at *X*. Opening switches *S* and S_1 and circuit breaker S_2 removes the faulty feeder and No. 3 transformer from the system. Power can be restored immediately and No. 3 power center fed through the low-voltage feeders connecting it to the rest of the system. If desirable No. 3 transformer can be restored to service by disconnecting the faulty feeder from switch S_1, then closing this switch and circuit breaker S_2.

Secondary-Loop Feeders

Because it may be necessary to carry all the load in one direction in the primary loop its conductors should be selected for the total system load. Normally a power center disconnected from the primary loop is fed in both directions through the secondary loop.

The secondary loop in addition to improving system reliability makes excess transformer capacity on one part

of the system immediately available to supply load in another part where transformers otherwise would be overloaded. For this reason less transformer capacity may be required to supply a comparable load than with the systems in Fig. 2 and 3. However, all transformer capacity is available to supply current to a fault on a secondary feeder. This increases the short-circuit current to where higher-interrupting-capacity circuit breakers may be required than on a comparable system with isolated power centers. Even though a saving may be made in transformer capacity and feeder copper because of diversity between load areas, Fig. 4, the secondary-loop copper and increased circuit-breaker capacity may make its cost higher than for the system in Fig. 3.

A single high-voltage feeder supplies power to systems in Fig. 1 to 4. Several primary-selective-radial systems have been developed in which the primary feeder is duplicated. In one of these, Fig. 5, the two primary feeders have sufficient capacity for the entire load. Switches at the power centers permit connecting their transformer to either high-voltage feeder, but normally one half of the transformers connect to each feeder. Then if a feeder fault develops on the primary only one half the load is interrupted. When this happens the power centers on the faulty feeder are switched to the one in service.

A transformer fault has the same effect as one on a loop feeder, but after opening its feeder switch, power can be restored to the other power centers by closing the feeder breaker that opened. This leaves the faulty power center without power until a temporary feeder can be run from it to other substations, or its transformer repaired.

Primary-Selective System

The primary-selective-feeder system can be applied to a banked-secondary-radial system like that in Fig. 4, known as a secondary-selective system. In one design of these systems each load center has two secondary busbars connected by a circuit breaker, and a transformer supplies each bus. The two transformers in each power center are of equal capacity and connect to separate primary feeders.

For greater reliability and flexibility than are provided by the systems described, a network system may be used. Electric power companies first developed such systems to increase reliability of their distribution lines. Later they were modified for industrial plants. Several arrangements have been used, such as simple network, spot network and primary-selective network. Fig. 6 shows the latter. Power is supplied to the power-center transformers by duplicate primary feeders. A switch permits connecting the transformers to either feeder, but normally they are divided between the two feeders.

Each transformer connects to its power-center bus through a circuit-breaker combination called a network protector. This breaker can be operated manually to disconnect its transformer from the secondary network. It may also be tripped automatically by a relay on power reversal caused by a fault in its transformer or on the primary feeder supplying the transformer. Such a fault would also automatically trip the circuit breaker at the supply end of the primary feeder.

When this happens the network protectors open on all transformers connected to this feeder. The total load is then supplied by the transformers remaining on the system, until the transformers on the faulty feeder can be switched to the good one. Temporarily, the transformers remaining in service may carry nearly 100% overload. This is satisfactory and eliminates the need for large spare transformer capacity.

Restoring voltage to the primaries of the disconnected transformers causes the reverse power relays to close the network protectors to connect them again to the system. On the primary side this system gives practically 100% reliability because neither a feeder nor a transformer fault can interrupt the power supply to the load.

For further information, see "Electric Power Distribution for Industrial Plants," by the American Institute of Electrical Engineers, New York, N. Y.

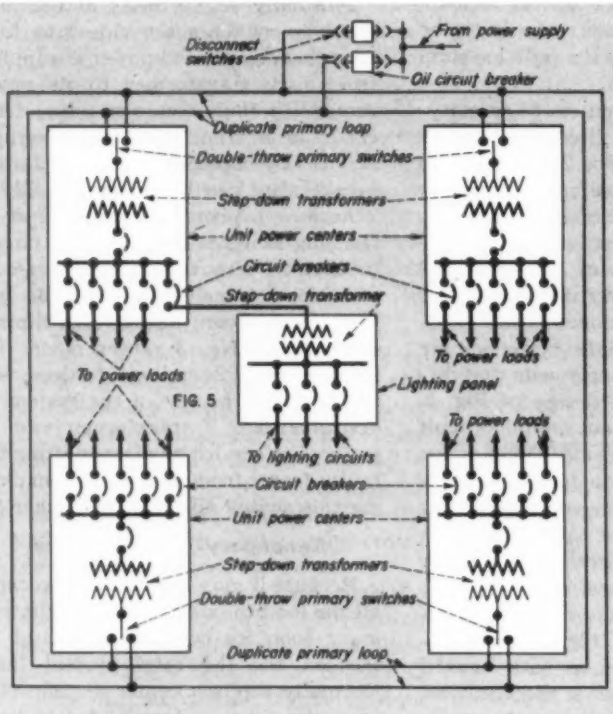


Fig. 5—Primary-selective distribution system has duplicate-primary feeders and radial low-voltage feeders

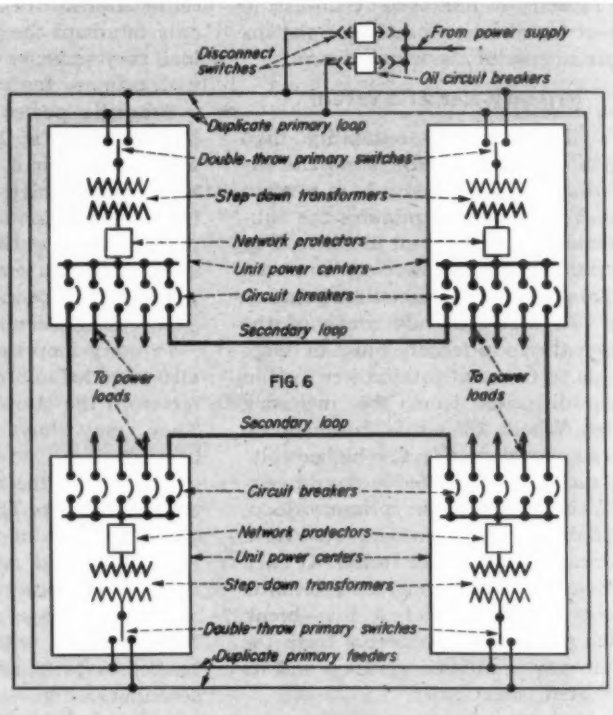


Fig. 6—Primary-selective network system has duplicate-primary feeders, network protectors and secondary loop

CONDUCTOR SIZES

Many factors are involved in selecting conductor sizes for electric power feeders to load centers and to individual loads, but they are practically all included in the elements that give a safe, reliable installation with low voltage drop and power losses. For short runs, conductors selected according to the National Electrical Code tables are generally sufficient. However, conductor sizes according to Code ratings may be inadequate for long feeders. Selection must then be based on calculations that take voltage drop into account.

Before considering these problems we will first give attention to the Code's table of current-carrying capacities of conductors. Copper-wire sizes are usually given in American Wire Gage (AWG) measurements. This gage gives the smaller wire sizes in numbers and the larger ones in their circular-mil (cm) cross-sectional area, as in the left-hand column of Table II. Standard wire sizes by numbers run from 40 to 0000. A No. 40, which is the smallest standard size, has a cross-sectional area of only 9.89 cm, 3.145 mils in diameter.

A mil is 0.001 in. and a circular mil is the area of a circle one mil in diameter. These units are convenient for expressing the size of wires, because the cross-sectional area of a solid round wire in circular mils equals the wire's diameter in mils squared. For example, the diameter of a 0000 wire is 460 mils and its cross-sectional area is 460 x 460 = 211,600 cm, Table III.

TABLE I – FULL-LOAD CURRENT OF DC AND 3-PHASE INDUCTION MOTORS

Motor	Dc motors full-load amp			Three-phase induction motors full-load amp				
Hp	115 V	230 V	550 V	110 V	220 V	440 V	550 V	2200 V
0.5	4.5	2.3		5.0	2.5	1.3	1	.....
0.75	6.5	3.3	1.4	5.4	2.8	1.4	1.1	.....
1	8.4	4.2	1.7	6.6	3.3	1.7	1.3	.....
1.5	12.5	6.3	2.6	9.4	4.7	2.4	2.0	.....
2	16.1	8.3	3.4	12	6	3	2.4	.....
3	23.0	12.3	5.0	.....	9	4.5	4	.....
5	40	19.8	8.2	.....	15	7.5	6	.....
7.5	58	28.7	12	.....	22	11	9	.....
10	75	38	16	.....	27	14	11	.....
15	112	56	23	.....	38	19	15	.....
20	140	74	30	.....	52	26	21	.....
25	185	92	38	.....	64	32	26	7
30	220	110	45	.....	77	39	31	8
40	294	146	61	.....	101	51	40	10
50	364	180	75	.....	125	63	50	13
60	436	215	90	.....	149	75	60	15
75	540	268	111	.....	180	90	72	19
100	.....	357	146	.....	246	123	98	25
125	.....	443	184	.....	310	155	124	32
150	.....	.....	220	.....	360	180	144	36
200	.....	.....	295	.....	480	240	195	49

Cross-Sectional Area

Do not confuse the cross-sectional area of round conductors with their diameters. Even though their cross-sectional area doubles every three sizes, their diameters double only every six sizes. This is as it should be since doubling the diameter of a circle does not increase its area by two but by four, or by its diameter squared.

The third column from the left of Table III gives the resistance per 1000 ft of round copper conductors at 59 F. No. 5 wire has a resistance of 0.3071 ohm per 1000 ft and No. 2, which is three sizes larger, has a resistance of 0.1532 ohm, or about one half that of a No. 5. This is as it should be because a No. 2 conductor has double the cross-sectional area of a No. 5, which is the same as connecting two No. 5 conductors in parallel. Here again we must be careful not to confuse a conductor's cross-sectional area with its diameter. If its cross-sectional area is doubled the resistance of an equal length of conductors is halved, but if its diameter is doubled, its resistance is decreased by four.

When wires are pulled into conduit they are usually stranded except in small sizes and even then it is good practice to use stranded conductors because they are less likely to break and cause trouble. The three right-hand columns, Table III, give number of strands in the conductors, the diameter of each strand and the bare outside diameter of the conductors. Their diameters are larger than those of solid conductors of equal cross-sectional area. For example, the diameter of a 250,000-cm solid conductor is 500 mils, as given in the fourth column from the left, where the outside diameter of the same conductor stranded is 0.594 in., or 594 mils. This difference is due to the space between the strands.

A solid conductor's size can be measured with a wire gage, but not that of a stranded one. The size of the latter, however, may be determined by measuring a strand's diameter in mils with a micrometer, squaring the diameter and multiplying the product by the number of strands. For example, a No. 2 conductor has seven strands 98 mils in diameter. The diameter squared is 98 x 98 = 9604 cm. Then the conductor with seven strands has a total cross-sectional area of 9604 x 7 = 67,228 cm, about the same as that of a No. 2 solid conductor.

Standard wire sizes larger than 0000 are expressed in circular mils and run from 250,000 to 2,000,000. The diameter of a solid round wire equals the square root of its cross-sectional area in mils. A 250,000-cm solid wire, Table III, has a diameter of 500 mils (0.5 in.) which is the square root of 250,000.

Table II gives the National Electrical Code carrying capacity of copper wires inclosed in raceways or cables, and in open air when the room temperature does not exceed 86 F (30 C). This table, which is based on the 1940 Code, is more involved than former wire tables because it includes several classes of insulation and gives more attention to conditions under which the conductors operate.

Excessive Temperature

Experience shows that excessive temperature is one of the greatest enemies of rubber and organic fibrous insulations. Their life decreases rapidly when subjected continuously to temperature beyond a given value.

The current flowing in a conductor produces heat proportional to the current in amperes squared, times the conductor's resistance in ohms. This heat must be dissipated from the conductor and the wall of its container to the surrounding air. Heat generated in the conductor cannot be dissipated as readily when the air temperature is high as when it is normal. Therefore correction factors for air temperatures above 86 F are given at the bottom of the table.

In the left-hand columns of the

TABLE II — CURRENT-CARRYING CAPACITY OF CONDUCTORS, IN AMPERES, ALLOWED BY THE NATIONAL ELECTRICAL CODE

	NOT MORE THAN THREE CONDUCTORS IN RACEWAY OR CABLE; ROOM TEMPERATURE 86 F							SINGLE CONDUCTOR IN FREE AIR; ROOM TEMPERATURE 86 F							
Size AWG or MCM	Rubber Type RW Type R	Synthetic Type SN Type RU Rubber Type RPT Type RP	Rubber Type RHT Type RH	Paper Synthetic Type SNA Asbestos varcam Type AVB varcam Type V	Asbestos varcam Type AVA Type AVL	Impregnated Asbestos Type AI	Asbestos Type A	Rubber Type R	Rubber Type RP	Rubber Type RHT Type RH	Synthetic Type SNA Asbestos varcam Type AVB varcam Type V	Asbestos varcam Type AVA	Impregnated Asbestos Type AI	Asbestos Type A	Slow-burning Type SB Weather-proof Type W Type SBW
11	15	18	22	23	28	29	32	20	24	29	30	39	40	43	23
12	20	23	27	29	36	38	42	26	31	37	40	51	52	57	30
10	25	31	37	38	47	49	54	35	42	50	54	65	69	75	40
8	35	41	49	50	60	63	71	48	58	69	71	85	91	100	53
6	45	54	65	68	80	85	95	65	78	94	99	119	126	134	70
5	52	63	75	78	94	99	110	76	92	110	115	136	145	158	80
4	60	72	86	88	107	114	122	87	105	125	133	158	169	180	90
3	69	83	99	104	121	131	145	101	122	146	155	182	194	211	100
2	80	96	115	118	137	147	163	118	142	170	179	211	226	241	125
1	91	110	131	138	161	172	188	136	164	196	211	247	264	280	150
0	105	127	151	157	190	202	223	160	193	230	245	287	306	325	200
00	120	145	172	184	217	230	249	185	223	267	284	331	354	372	225
000	138	166	199	209	243	265	284	215	259	310	330	384	410	429	275
0000	160	193	230	237	275	308	340	248	298	358	383	446	476	510	325
250	177	213	255	272	315	334	372	280	338	403	427	495	528	562	350
300	198	238	285	299	347	380	415	310	373	446	480	555	592	632	400
350	216	260	311	325	392	419	462	350	421	504	529	612	653	698	450
400	233	281	336	361	418	450	488	380	457	547	575	665	710	755	500
500	265	319	382	404	468	498	554	430	517	620	660	765	814	870	600
600	293	353	422	453	525	543	612	480	577	691	738	857	912	970	680
700	320	385	461	488	562	598	668	525	632	756	813	942	1003	1065	760
750	330	398	475	502	582	621	690	545	655	785	846	981	1044	1118	800
800	340	410	490	514	600	641	720	565	680	815	879	1020	1085	1150	840
900	360	434	519	556	.....	.....	.....	605	728	872	941	.....	.....	.....	920
1000	377	455	543	583	681	730	811	650	782	936	1001	1163	1238	1332	1000
1250	409	493	589	613	.....	.....	.....	740	890	1066	1131	.....	.....	.....	.....
1500	434	522	625	698	784	.....	.....	815	980	1174	1261	1452	.....	.....	1360
1750	451	544	650	733	.....	.....	.....	890	1070	1282	1370	.....	.....	.....	.....
2000	463	558	666	774	839	.....	.....	960	1155	1383	1472	1713	.....	.....	1670

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER 86 F

C	F														
40	104	0.71	0.82	0.88	0.90	0.94	0.95	.....	0.71	0.82	0.88	0.90	0.94	0.95	.....	.....
45	113	0.50	0.71	0.82	.....	.....	.....	.....	0.50	0.71	0.82	.....	.....	.....	.....	.....
50	122	0.00	0.58	0.75	0.80	0.87	0.89	.....	0.00	0.58	0.75	0.80	0.87	0.89	.....	.....
55	131	.....	0.41	0.67	.....	.....	.....	.....	.....	0.41	0.67	.....	.....	.....	.....	.....
60	140	.....	0.00	0.58	0.67	0.79	0.83	0.97	.....	0.00	0.58	0.67	0.79	0.83	0.97	.....
70	158	.....	.....	0.35	0.52	0.71	0.76	0.93	.....	.....	0.35	0.52	0.71	0.76	0.93	.....
75	167	.....	.....	0.00	.....	.....	.....	.....	.....	.....	0.00	.....	.....	.....	.....	.....
80	176	.....	.....	.....	0.30	0.61	0.69	0.89	.....	.....	.....	0.30	0.61	0.69	0.89	.....
90	194	.....	.....	.....	.....	0.50	0.61	0.86	.....	.....	.....	.....	0.50	0.61	0.86	.....
100	212	.....	.....	.....	.....	.....	0.51	0.82	.....	.....	.....	.....	.....	0.51	0.82	.....
120	248	.....	.....	.....	.....	.....	.....	0.72	.....	.....	.....	.....	.....	.....	0.72	.....
140	284	.....	.....	.....	.....	.....	.....	0.63					.....	.....	0.63	.....

correction factors, under "C" and "F" air temperatures are given in degrees Centigrade and Fahrenheit, respectively. The other columns give correction factors by which the conductor's current-carrying capacities must be multiplied if air temperature exceeds 86 F. For example, a No. 1 wire insulated with Type R or RW rubber can be loaded to 91 amp if the air temperature does not exceed 86 F. For a room temperature of 100 F, the Code permits the conductor to be loaded to only 71% of its normal rating, or 91 x 0.71 = 65 amp.

Above 113-F room temperature, Types R and RW rubber-insulated conductors are not permitted because 122 F is the allowable maximum for this insulation. The Code specifies that if the room temperature is within 10 C of the maximum allowable operating temperature of the insulation, it is desirable to use an insulation with a higher maximum allowable operating temperature. For maximum allowable temperatures for the different types of insulations see the table on page 81.

Generally for temperatures above that for normal air a conductor with

the better grades of rubber insulation is more economical because of the higher loading permitted and their higher correction factors for temperatures above normal, as indicated in Table II.

The Code also requires a reduction in the allowable carrying capacity of conductors when there are more than three in a raceway. If from four to six conductors are installed in a raceway or cable their allowable carrying capacity must be reduced to 80% of the values given for three conductors in the table. For seven to nine conductors in a raceway or cable the carrying capacity must be reduced to 70% of that for three in the table. Type R or RW insulated No. 6 conductor has a current-carrying capacity of 45 amp, when the room temperature does not exceed 86 F. If six of the conductors are put in a single raceway the carrying capacity of each must be reduced to 45 x 0.8 = 36 amp.

The right-hand half of Table II gives current-carrying capacities of single insulated conductors in free air. Because these conductors can dissipate more readily the heat produced in them, they have a higher current-carrying capacity than those in raceways. However, the regulations regarding air temperatures above 86 F, applying to conductors in raceways, apply to those run on insulators in open air.

Conductor sizes selected according to the current-carrying capacities are ample for distances up to about 300 ft, but will be found too small for long runs. For the latter, conductors must be selected on the basis of an allowable voltage drop. Of course, a conductor so calculated must be at least as large for a given current as specified in Table II; if not, the table size must be used.

First let us consider selection of conductor sizes for a single dc motor and its control. Assume a 25-hp 230-v dc motor that requires 30-ft conductors for connection to its control run in conduit. How large should these conductors be? The Code requires that branch-circuit conductors supplying an individual motor shall have a current-carrying capacity not less than 125% of the motor's full-load rating. Some authorities consider it better practice to select motor conductors on the more liberal basis of starting current, but the following problems use the 125% rule, as required by the Code.

The full-load current of a 25-hp 230-v dc motor, Table I, is 92 amp.

TABLE III—PROPERTIES OF SOLID AND STRANDED WIRE AND CABLE

Wire size, AWG gage	Wire size, Cm	Ohms per 1000 ft, 59 F	Solid conductor, bare dia, mils	Stranded copper wire — Wires — No.	Stranded copper wire — Wires — Dia each, mils	Bare outside dia, in.
14	4107	2.475	64	7	24	0.073
12	6530	1.557	81	7	31	0.092
10	10,380	0.9792	101	7	39	0.116
8	16,510	0.6158	128	7	48	0.145
6	26,250	0.3872	162	7	61	0.184
5	33,100	0.3071	182	7	69	0.206
4	41,740	0.2436	204	7	77	0.231
3	52,630	0.1931	229	7	87	0.260
2	66,370	0.1532	258	7	98	0.293
1	83,690	0.1215	289	19	66	0.332
0	105,500	0.09633	325	19	75	0.373
00	133,100	0.07639	365	19	84	0.419
000	167,800	0.06058	410	19	94	0.471
0000	211,600	0.04804	460	19	106	0.528
	250,000	0.04147	500	37	82	0.594
	300,000	0.03457	548	37	90	0.641
	350,000	0.02963	592	37	97	0.683
	400,000	0.02592	633	37	103	0.734
	500,000	0.02074	707	37	91	0.828
	600,000	0.01729	775	61	99	0.892
	700,000	0.01481	837	61	107	0.968
	750,000	0.01382	866	61	111	1.000
	800,000	0.01296	894	61	115	1.031
	900,000	0.01153	949	61	121	1.093
	1,000,000	0.01036	1000	61	128	1.172
	1,250,000	0.00829	1118	91	117	1.290
	1,500,000	0.00692	1225	91	133	1.412
	1,750,000	0.00593	1323	127	117	1.546
	2,000,000	0.00518	1414	127	125.5	1.632

TABLE IV—RATIO OF REACTANCE X TO RESISTANCE R

For conductors in conduit on 60-cycle system

Wire size, AWG	X-R ratio	Wire size Cm	X-R ratio
5	0.14	250,000	0.85
4	0.15	300,000	1.01
3	0.22	400,000	1.49
2	0.26	500,000	1.75
1	0.32	600,000	1.85
0	0.38	700,000	2.06
00	0.54	800,000	2.49
000	0.64	900,000	2.69
0000	0.76	1,000,000	2.89

Then the conductor size must be selected for 92 x 1.25 = 115 amp. Referring to Table II, the nearest size Type R wire is No. 00, which has a carrying capacity of 120 amp in conduit and a room temperature of 86 F or less. A No. 0 Type RP, rated 127 amp, or a No. 2 Type RH wire, rated 115 amp, can be used. For flexibility, the conductors have to be stranded, as in Table III, and because of the Code requirement that conductors size No. 6 and larger installed in raceways must be stranded, except when used for busbars.

If this motor were supplied by a feeder 300 ft long from a load center, Fig. 1, then a check should be made for voltage drop in the conductors. Voltage drop in a dc circuit equals the current in amperes in the circuit, times the circuit resistance in ohms. If the current is 90 amp and the circuit resistance 0.03 ohms, then the voltage drop is 90 x 0.03 = 2.7 v drop. This means that if the voltage at the supply of the circuit is 230, at the load it is 230 − 2.7 = 227.3 v.

Keep Voltage Drop Low

Conductors should be of such a size that voltage drop is not excessive; otherwise operation is unsatisfactory. Overvoltage during light loads causes short lamp life. Voltage during heavy loads may be so low that lamps do not provide sufficient illumination, and flicker when motors are started. Unsatisfactory motor starting, speed regulation or temperature rise of motors may result from excessive voltage drop.

A standard voltage drop has not been adopted and different interested agencies do not entirely agree, except that the voltage drop should not exceed 5% from the supply end of the main feeder to utilizing device for power circuits and 3% for lighting and combination power and lighting. The National Electrical Code recommends that feeder conductors be of such a size that voltage drop up to the final

distribution point for the load will not be more than 3% for power and not more than 1% for light and combined lighting and power loads. If, for power loads, conductors are selected of a size that keeps the total voltage drop within 5% they are satisfactory. This drop can be divided: 4% in the mains and feeders and 1% in the branches to the individual loads.

Voltage drop in a dc circuit may be determined by the formula:

$$Ed = \frac{24\ D\ I}{CM}$$

where D is length in feet of the conductors one way in the circuit, I the current in amperes and CM the cross-sectional area of the conductors in circular mils.

Going back to our problem the motor was assumed to be supplied over a feeder 300 ft long from the main switchboard to the starter panel. If we use a No. 00 Type R wire, which has a 133,100-cm cross-sectional area, Table III, the voltage drop in the feeder is: $Ed = 24 \times 300 \times 92 \div 133{,}100 = 5$ v, or a little over 2%. With a No. 2 Type RH wire, which has 66,370-cm cross-sectional area, the voltage drop is $Ed = 24 \times 300 \times 92 \div 66{,}370 = 10$ v, or 4.3%. This size conductor is satisfactory because of the short run from the starter to the motor; the total drop from switchboard to motor is less than 5%.

Motor-Group Conductors

Where conductors are to supply a group of two or more motors the Code requires that they have a current-carrying capacity of not less than 125% of the full-load current of the largest motor in the group, plus the sum of the full-load current of the remainder of the motors in the group.

Assume that a feeder is to be selected for a group of 230-v dc motors that includes two 10-hp, two 15-hp and a 25-hp motor, Fig. 2. Conductors for each motor are selected as in the previous problem. They must have a current-carrying capacity of not less than 125% of the motors, full-load current. The 10-hp motors have a full-load current of 38 amp, Table I, and their conductors have to be good for $38 \times 1.25 = 48$ amp.

Full-load current of the 15-hp motors is 56 amp and their conductors have to be good for $56 \times 1.25 = 70$ amp. The 25-hp motor full-load current rates 92 amp and its conductors must be selected for $92 \times 1.25 = 115$ amp. If we use Type R wire, the 10-hp motors require No. 5; the 15-hp, No. 2, and the 25-hp, No. 00. The feeder must be selected for a load equal to 125% of the full-load current of the 25-hp motor, plus the full-load current of each of the other motors, or a total of $115 + (2 \times 38) + (2 \times 56) = 303$ amp, which requires 700,000-cm Type R conductors.

If Type RP conductors are selected 500,000-cm size can be used, whereas if Type RH are selected 350,000-cm will satisfy the Code and probably be the most economical. The reduction in size of conductors also permits a reduction in conduit size from 3½ in. for two 700,000-cm Type R conductors to 2½ in. for two 350,000-cm Type RH conductors.

If the feeder is quite long voltage drop may be the determining factor. Then the larger-sized Type R conductors will have to be used. Assume that the feeder is 200 ft long. Total full-load current of the five motors is $92 + (2 \times 56) + (2 \times 38) = 280$ amp. Then for the Type RH conductors the voltage drop $Ed = 24 \times 200 \times 280 \div 350{,}000 = 4$ v, or less than 2% drop. This size Type RH conductor may be used as well as the larger-size Type R or RP conductors, and is good for 167 F compared to 122 F for Type R wire.

Conductor sizes for ac motors are selected in practically the same way as for dc motors, except that circuit reactance and other factors may have to be considered in large-sized conductors. Assume a group of 3-phase 440-v squirrel-cage motors (two 15-hp, two 25-hp and one 50-hp) supplied over a feeder 300 ft long from a power-plant switchboard, Fig. 3. Find the size of conductors for each motor circuit and feeder conductors for the group.

Ac-Motor Conductor Sizes

Full-load current of the 15-hp motors is 19 amp, of the 25-hp 32 amp, and of the 50-hp 63 amp, Table I. The 15-hp motors require conductors large enough for $19 \times 1.25 = 24$ amp, or a No. 10 Type R or RP or a No. 12 RH. The 25-hp motors have a full-load current of 32 amp and require conductors good for $32 \times 1.25 = 40$ amp, or a No. 6 Type R, or No. 8 Type RP or RH. Full-load current of the 50-hp motor is 63 amp and requires a conductor good for $63 \times 1.25 = 79$ amp, or a No. 2 Type R, a No. 3 RP, or a No. 4 RH may be selected.

The feeder conductor must be selected for $(63 \times 1.25) + (19 \times 2) + (32 \times 2) = 181$ amp which requires 300,000-cm Type R conductors. Voltage drop in a 3-wire 3-phase circuit equals dc voltage drop, times drop factor, times 0.866. The full-load current of the five motors is $63 + (19 \times 2) + (32 \times 2) = 165$ amp.

TABLE V—DROP FACTORS FOR AC CIRCUITS AT DIFFERENT POWER FACTORS

RATIO OF REACTANCE TO RESISTANCE	*POWER FACTOR* 1.00	0.90	0.85	0.80	0.70
	DROP FACTOR				
0.1	1.00	1.00	0.94	0.88	0.80
0.2	1.00	1.01	0.98	0.92	0.86
0.3	1.00	1.05	1.02	0.99	0.93
0.4	1.00	1.10	1.08	1.04	1.00
0.5	1.00	1.14	1.13	1.10	1.07
0.6	1.01	1.18	1.19	1.15	1.14
0.7	1.02	1.23	1.24	1.21	1.20
0.8	1.02	1.28	1.29	1.28	1.27
0.9	1.03	1.33	1.34	1.34	1.35
1.0	1.04	1.37	1.39	1.40	1.41
1.1	1.05	1.41	1.44	1.45	1.48
1.2	1.06	1.46	1.50	1.51	1.55
1.3	1.07	1.51	1.55	1.57	1.62
1.4	1.08	1.55	1.61	1.64	1.70
1.5	1.10	1.60	1.67	1.70	1.77
1.6	1.10	1.65	1.74	1.77	1.85
1.7	1.13	1.70	1.79	1.84	1.92
1.8	1.15	1.76	1.85	1.91	1.99
1.9	1.17	1.82	1.91	1.98	2.06
2.0	1.18	1.87	1.96	2.04	2.14
2.1	1.20	1.92	2.03	2.10	2.21
2.2	1.22	1.98	2.09	2.17	2.29
2.3	1.23	2.03	2.15	2.23	2.37
2.4	1.25	2.09	2.22	2.30	2.44
2.5	1.27	2.14	2.28	2.37	2.52
2.6	1.30	2.20	2.34	2.44	2.60
2.7	1.32	2.26	2.41	2.51	2.68
2.8	1.35	2.32	2.47	2.57	2.76
2.9	1.37	2.39	2.54	2.64	2.83
3.0	1.40	2.45	2.60	2.72	2.90

Then, the dc voltage drop $Ed = 24 \times 300 \times 165 \div 300{,}000 = 3.95$, or 4 v.

To determine drop factor the ratio of reactance to resistance of the conductors and the power factor of the load must be considered. Power factor of induction motors varies with their rated horsepower, speed and design. For 1800-rpm general-purpose squirrel-cage motors, the full-load power factor may be taken as 0.85. For the smaller-sized motor it drops to about 0.80, and the larger motor is over 0.90, but 0.85 is close enough for most purposes.

The 60-cycle ratio of reactance to resistance of 300,000-cm conductors installed in conduit is 1.01, Table IV. Drop factor for this ratio of reactance to resistance and a 0.85 power factor is 1.39, Table V. Then the voltage drop $Ed = 4 \times 1.39 \times 0.866 = 4.8$, say 5 v, or a little over 1%, which is well on the side of good practice.

The foregoing gives a general idea of how problems of conductor selection for motors are handled. Those who wish more complete information are referred to the wire and cable manufacturers' literature, *American Electricians Handbook*, McGraw-Hill Book Co, and *Electrical Power Distribution for Industrial Plants*, American Institute of Electrical Engineers.

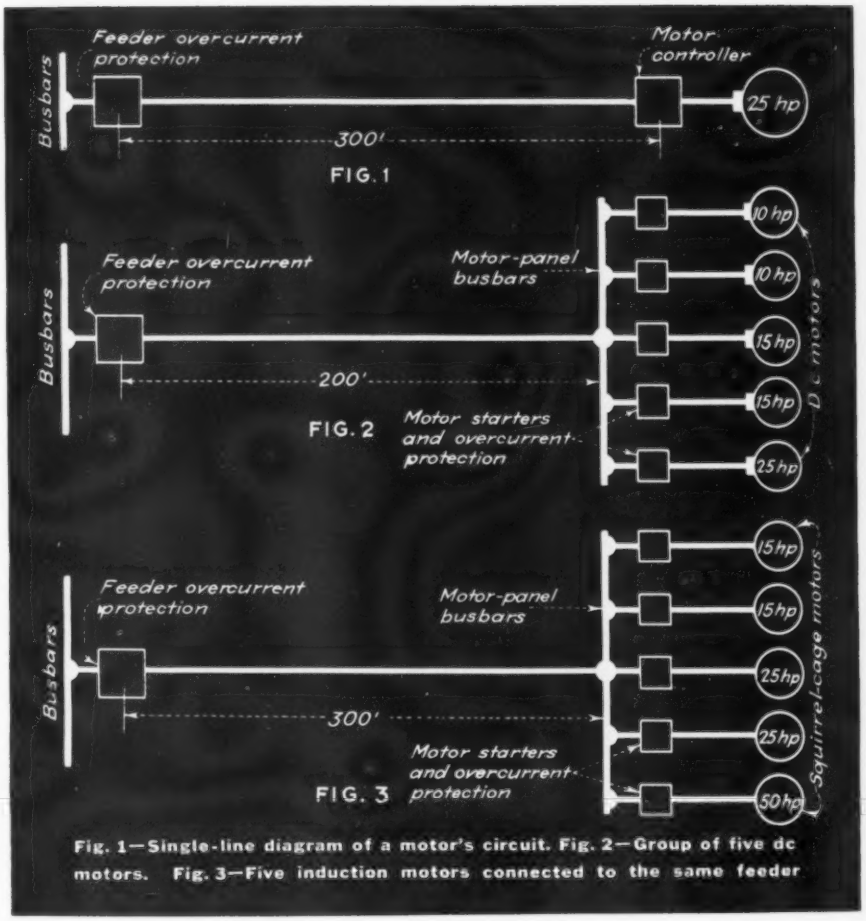


Fig. 1—Single-line diagram of a motor's circuit. Fig. 2—Group of five dc motors. Fig. 3—Five induction motors connected to the same feeder

CIRCUIT PROTECTION

Circuit protection may assume different forms according to the equipment to be protected and conditions that must be guarded against. This article gives attention chiefly to protection of electric motors, their branch and feeder circuits, as recommended by the National Electrical Code, and other requirements. Protection for motors and their circuits may be divided into overload, low voltage, phase failure, phase reversal, and other conditions.

Overload protection is primarily intended to prevent damage to branch and feeder circuits that would be a fire hazard. When properly selected it also protects these circuits from overloads that would increase their temperature beyond the safe limit of their insulation. This overload protection guards the motor against insulation failures that produce the equivalent of external short-circuit or ground, but not against operating overloads. The latter is part of the motor's starting and control equipment.

Fuses, circuit breakers, thermal cutouts, thermal relays or magnetic relays all provide overload protection. A fuse, the oldest form of overload protection, consists of a fusible metal strip connected in series in the circuit to carry the full current. It melts if this current exceeds a given value. Early fuse designs consisted of open links held between two terminals. Modern fuses, however, are inclosed and some are designed to have an inverse-time characteristic to a limited degree.

Branch-circuit wiring must have a carrying capacity of at least 125% of the motor's full-load current. Continuous-duty motors shall have running overcurrent protection of not over 125% of their rated full-load current. Where this value of current does not correspond to standard size of fuses and other protective devices the next larger size may be used. But it should not exceed 150% of the motor's rated full-load current, which is necessary to take care of starting requirements and other conditions. Fuses selected on this basis fail, however, to protect the motor against overloads.

A circuit breaker may be classed as a switch that trips open under overload and other conditions. Usually the overload current that trips a circuit breaker can be adjusted over a range of about 100%, for example between 250 and 500 amp. Circuit breakers can be equipped with instantaneous-overcurrent, time-delay-overcurrent, thermal-overcurrent, thermal-magnetic-overcurrent, undervoltage and reverse-phase trips or combinations of these. They can be manually closed or closed magnetically from a remote location.

Kind of Circuit Protection

Kind of protection and how applied is determined largely by the National Electrical Code, which requires protection of all ungrounded conductors. If fuses are used, one must be placed in each ungrounded conductor, Fig. 1 and 2. With overload trip coils or relays the protective device must open all ungrounded conductors. However, on a 2-wire dc or ac circuit only one overcurrent coil is required, Fig. 3, but two coils, one in each leg of the circuit, are preferable.

On a 2-wire circuit with one leg permanently grounded the protective device need open only the ungrounded leg and be tripped by an overcurrent coil in that leg, Fig. 4. A 3-wire system with grounded neutral must have both ungrounded conductors protected by an overcurrent unit in each leg, Fig. 5.

For a 3-wire 2-phase system with the

common wire grounded or ungrounded the Code requires that an overcurrent unit be placed in each of the outside legs, Fig. 6. However, when the system is ungrounded it is preferable that the common conductor also be opened, Fig. 7, when the breaker is tripped by either of the overcurrent units in the outside legs. When such a breaker is used its center pole must have a capacity equal to 140% of an outer pole.

An ungrounded 3-phase system, or one with a grounded neutral, requires protection in all three leads and if a circuit breaker is used, a trip coil must be placed in each circuit leg, Fig. 9. If one circuit leg is permanently grounded, then protection is required in the two ungrounded conductors only, Fig. 10. These and other protection requirements are clearly set forth in the Code. Wherever circuit breakers are shown fuses may be substituted.

The National Electrical Code gives a comprehensive table of conductor sizes and overcurrent protection for motors. The following example indicates how the table is used. Assume a 25-hp 220-v 3-phase motor, which has a full-load current of 64 amp. A No. 2 Type R conductor is the minimum size permitted for this current in a raceway.

ACKNOWLEDGMENTS

For material used in preparing the articles in this special section, POWER is indebted to Anaconda Wire & Cable Co, Allis-Chalmers Mfg Co, Bulldog Elec Products Co, Bussmann Mfg Co, Cutler-Hammer, Inc, Economy Fuse & Mfg Co, Frank Adams Elec Co, General Elec Co, General Cable Corp, Habirshaw Cable & Wire Corp, I-T-E Circuit Breaker Co, John A Roebling's Sons Co, National Elec Products Corp, Okonite Co, Rockbestos Products Corp, Simplex Wire & Cable Co, Square D Co, Star Fuse Co, Trumbull Elec Mfg Co, Trico Fuse Co, and Westinghouse Elec Corp.

This is not the minimum size of Type R wire the Code requires for 64 amp but is the size needed for motor full-load current plus 25%, which is 80 amp. As explained on page 91, motor branch-circuit wiring must be a size that carries 125% full-load current. The table permits this size conductor to be fused to 80 amp for running protection of the motor. If the motor is protected by a time-limit device, such as a thermal relay or an overcurrent trip on a circuit breaker, it must be set to trip at not more than 80 amp.

When the motor is started on full voltage or through a resistance or a reactor the branch-circuit protection, Fig. 8, can be 200-amp fuses or 125-amp if the motor is started on reduced voltage. For a dc or a wound-rotor ac motor, branch-circuit protection must not exceed 100 amp.

Feeder protection depends on the number and size of motors on it. The Code requires that a feeder supplying several motors shall be provided with overcurrent protection not greater than the largest rating or setting of the branch-circuit protective device for any motor, plus the sum of the full-load currents of the other motors of the group.

For example, assume that in Fig. 8 the feeder supplies one 25-hp and two 15-hp 440-v squirrel-cage motors. The 25-hp motor has a full-load current of 32 amp and its branch circuit can be fused to 100. The two 15-hp motors each have a full-load current of 19 amp. Therefore the feeder may be fused for a total of 100+19+19=138 amp, or with 150-amp fuses.

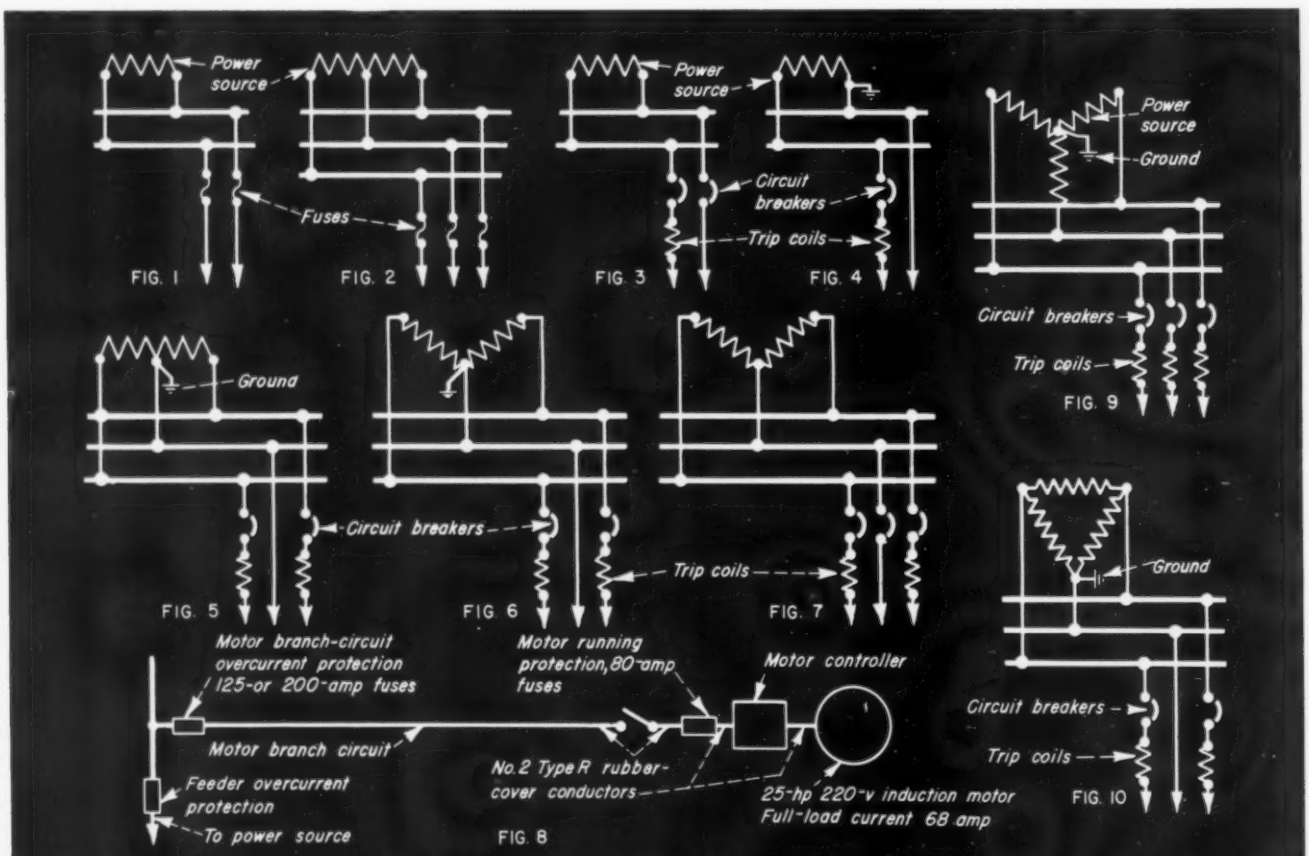
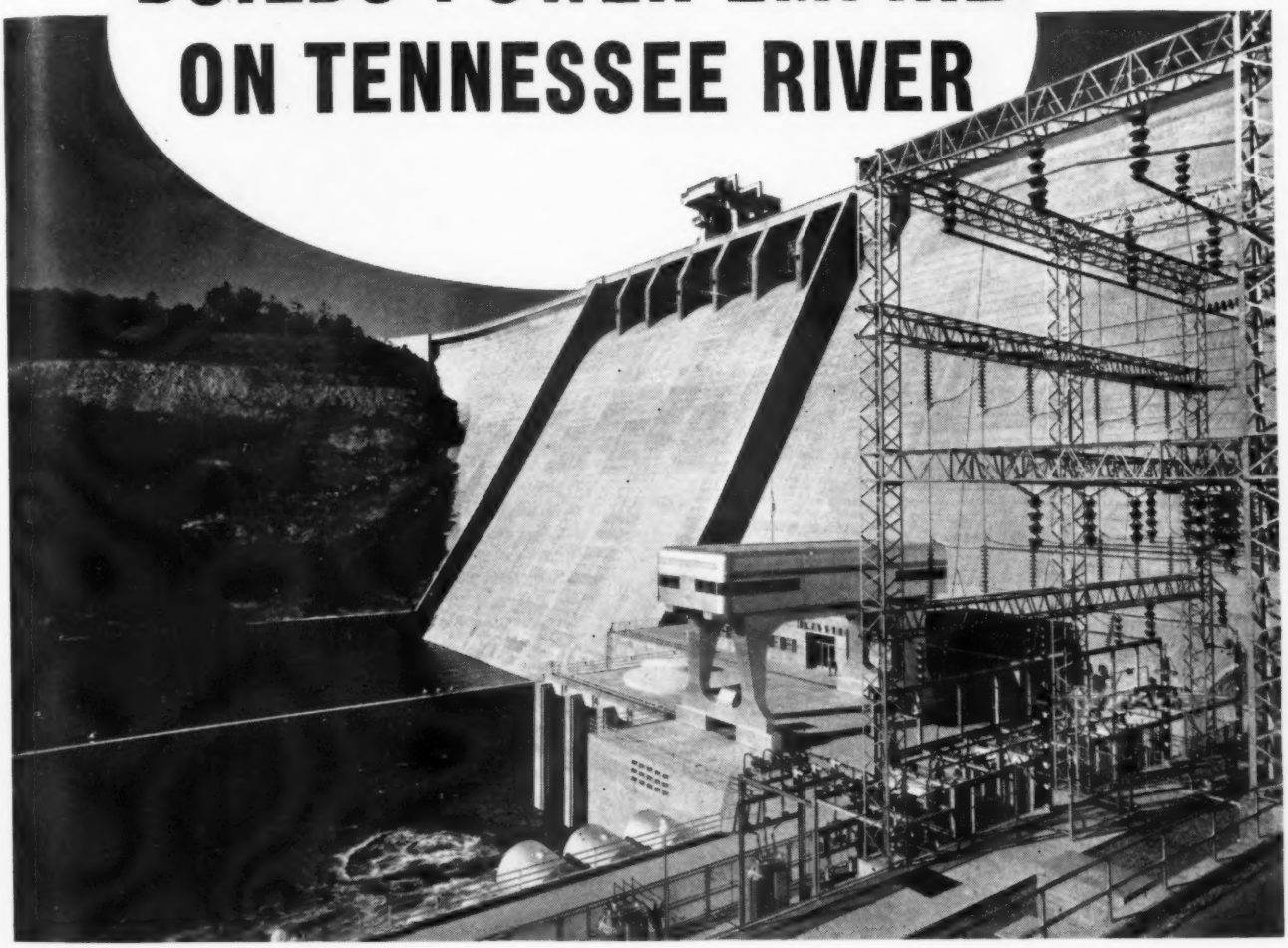


Fig. 1 to 7—Fuse and circuit-breaker protection for 2-wire, 3-wire and 2-phase circuits. Fig. 8—Layout of a motor's branch and feeder circuits and their protection. Fig. 9 and 10—Overload protection of 3-wire 3-phase circuits

TVA BUILDS POWER EMPIRE ON TENNESSEE RIVER



Hiwassee Dam, 307.5 ft high, on the Hiwassee River in North Carolina has one 57,600-kw (80,000 hp) unit installed with space for a future second one

▶ DEVELOPMENT of the Tennessee River system during the last twelve years, through 16 dams constructed and placed in operation by the Tennessee Valley Authority has turned a once intractable and relatively useless stream into one of the most completely controlled watercourses in the world. This river now produces tremendous amounts of electric power, provides a modern navigation channel 650 miles long, and assures a large measure of flood control in the basins of the Tennessee, lower Ohio and Mississippi River.

War demands have vastly increased the river system's power development since 1940 with construction and initial operation of ten hydroelectric plants and a large steam-generating station. In TVA area, total installed capacity has increased from about 600,000 kw in 1933 to over 2,200,000 kw, while power generation for the same period increased from one- to over 10-billion kwhr. Of total installed TVA capacity, 1,760,960 kw are in major hydro plants and 425,000 in major steam plants.

Under an agreement reached when it acquired the site for Fontana Dam, on the Little Tennessee River, TVA operates as an integral part of its system five major hydro developments of the Aluminum Co of America—Calderwood, Cheoah, Santeetlah, Nantahala and Glenville—with an installed capacity of 307,000 kw. This makes a total installed capacity on the TVA system of over 2,500,000 kw and 27 major dams. Integrated operation of the two systems permits more efficient use of water for power generation—the added power being divided between TVA and the Aluminum Company.

In addition to the 16 dams constructed since 1933, TVA operates five dams acquired in 1939 from a public utility company and Wilson Dam, transferred to TVA by the War Department in 1933. It also operates five steam plants including the new 240,000-kw Watts Bar plant, three (Hales Bar, Nashville and Parksville) purchased from a public utility, and Wilson steam plant, built by the government in 1918 at Muscle Shoals. TVA also leases a 20,000-kw steam plant at Memphis. Because of large coal resources in the Tennessee Valley region steam plants are used extensively to supplement hydro generation and firm-up secondary hydro power.

(*Continued on page* 98)

In the SOUTH SMOKESTACKS ARE GROWING.

A large Riley Installation in the Sou
450,000 lbs. hr. 1425 lbs. Press. 900

—and you will find RILEY STEAM GENERATING UNITS under many of the more recent ones

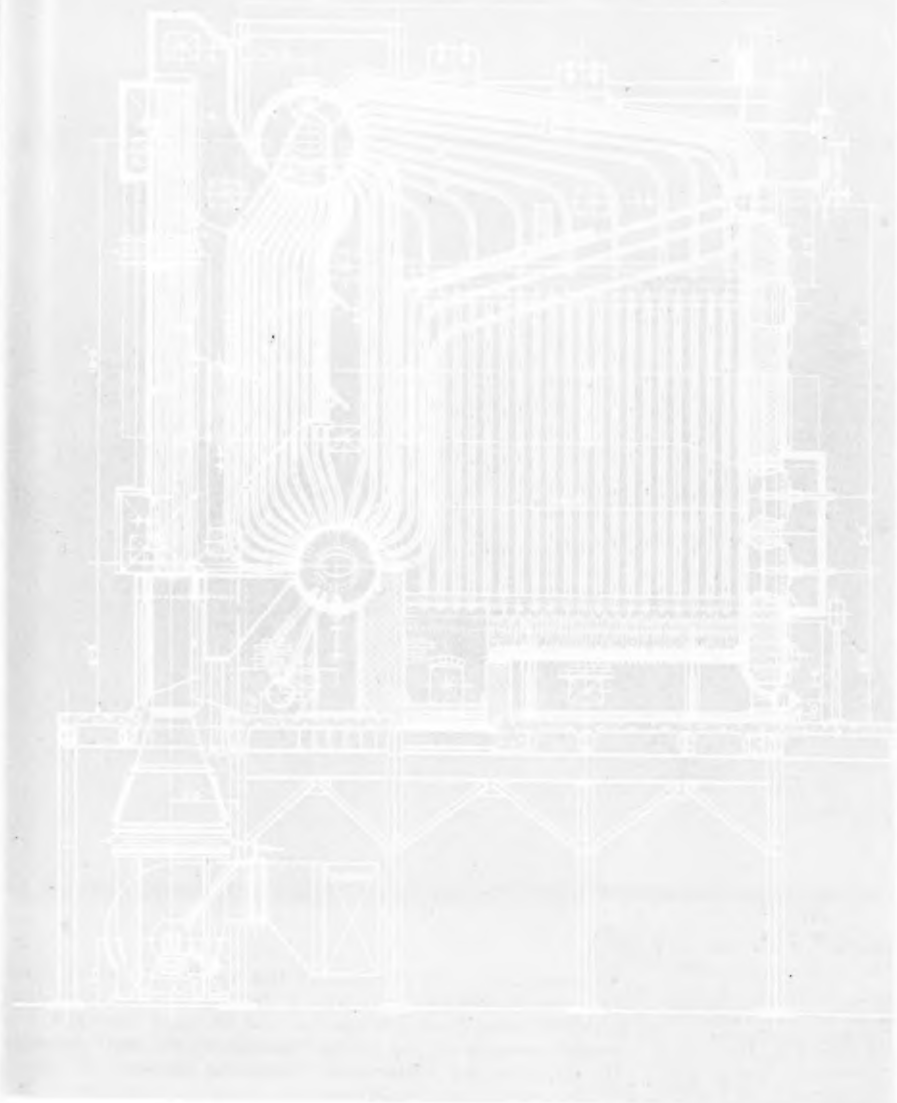
The increase in the number of plants using Riley Steam Generating Units in the South has more than kept pace with the rapid industrial expansion there. An indication of the growing preference for Riley Units

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

t will pay you to visit modern Riley Installations



Masonite Corporation, Laurel, Miss.
75,000 lbs. hr. 450 lbs. Press.
Masonite has also installed a 1225 lbs. pressure Riley Boiler and two 450 lbs. pressure 750 F. Riley Boilers.

MASONITE is another well-known Southern Industry which has placed several repeat orders for Riley Steam Generating Units.

A Few Riley Installations in the South

Dow Chemical Co., Freeport, Texas
Dow Magnesium Co., Velasco, Texas
Houston Lighting & Power Co., Houston, Texas
Florida Power & Light Co., Ft. Lauderdale, Fla.
Gulf Power Co., Pensacola, Fla.
Mississippi Power Co., Hattiesburg, Miss.
Marietta Aircraft Plant, Bellcraft, Ga.
Standard Oil Co. of Louisiana Baton Rouge, La.
Masonite Corp., Laurel, Miss.
Humble Oil & Refining Co., Baytown, Texas
Sunflower Ordnance Works, Eudora, Kan.
Gaylord Container Corp., Bogalusa, La.
Celanese Corp. of America, Narrows, Va.
Celanese Corp. of America, Cumberland, Md.
Carolina Power & Light Co., Moncure, N. Ca.
Savannah Sugar Refining Co., Savannah, Ga.
Godchaux Sugars, Inc., Reserve, La.
W. Va. Pulp & Paper Co., Charleston, W. Va.
International Min. & Chem. Co., Dallas, Texas
Mead Corp., Sylva, N. Ca.
Revere Copper & Brass Co., Baltimore, Md.
Republic Creosoting Co., Norfolk, Va.
Celanese Corp of Amer., Bishop, Texas
Crown Cork & Seal Co., Baltimore, Md.
Ft. Worth Aircraft Plant, Fort Worth, Texas
Lexington Water Works, Lexington, Ky.
Lone Star Steel Co., Daingerfield, Texas
T. V. A., Wilson Dam, Ala.
Standard Oil Co. of N. J., Baltimore, Md.
U. S. Marine Barracks, New River, N. Ca.
Yazoo Munc. Plant, Yazoo, Miss.
Curtiss-Wright Corp., Louisville, Ky.
South Carolina Power Co., Charleston, S. Ca.

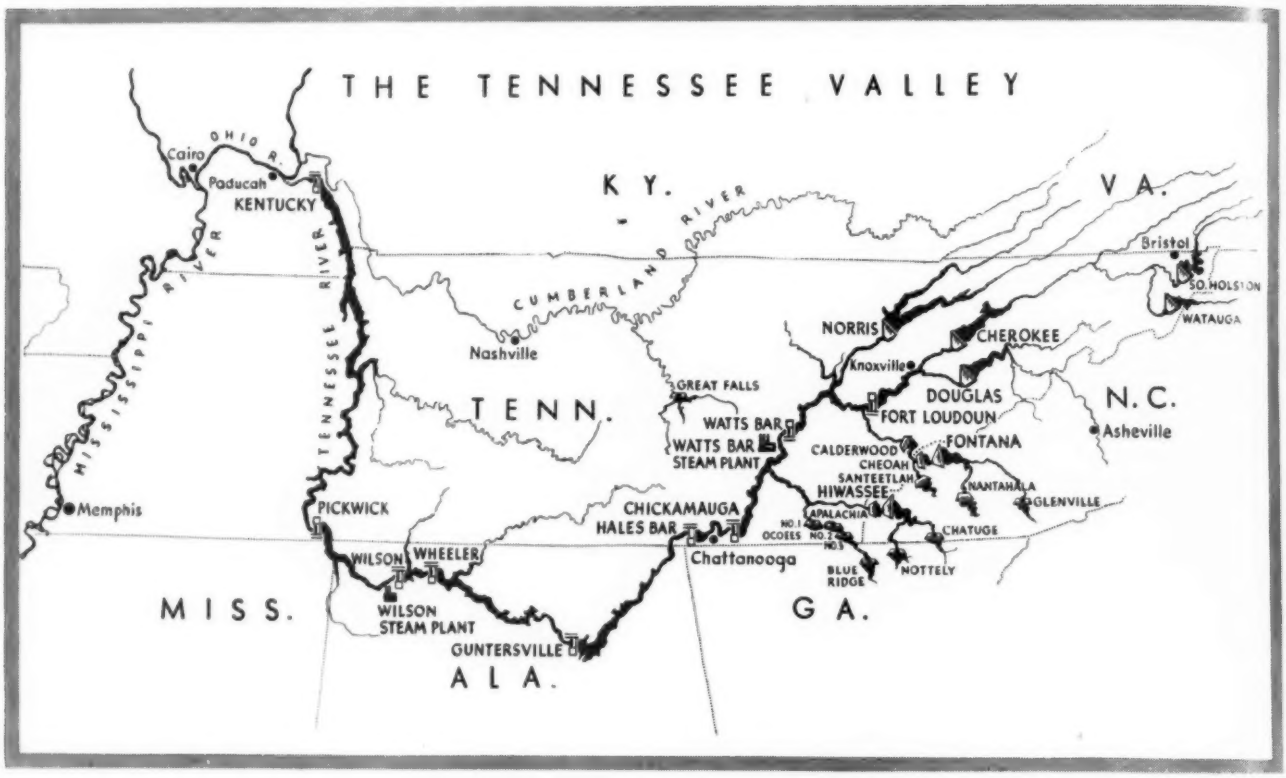
A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

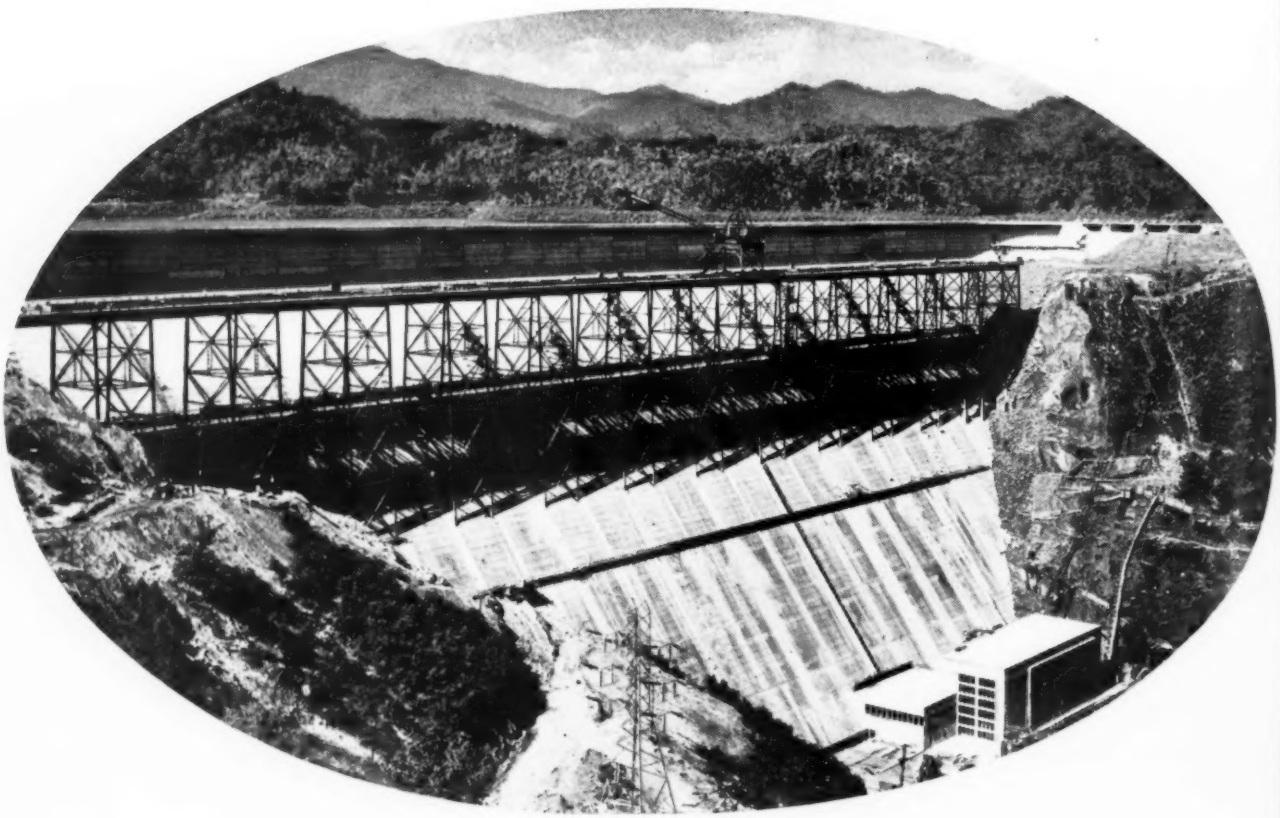
before purchasing Boiler or Fuel Burning Equipment

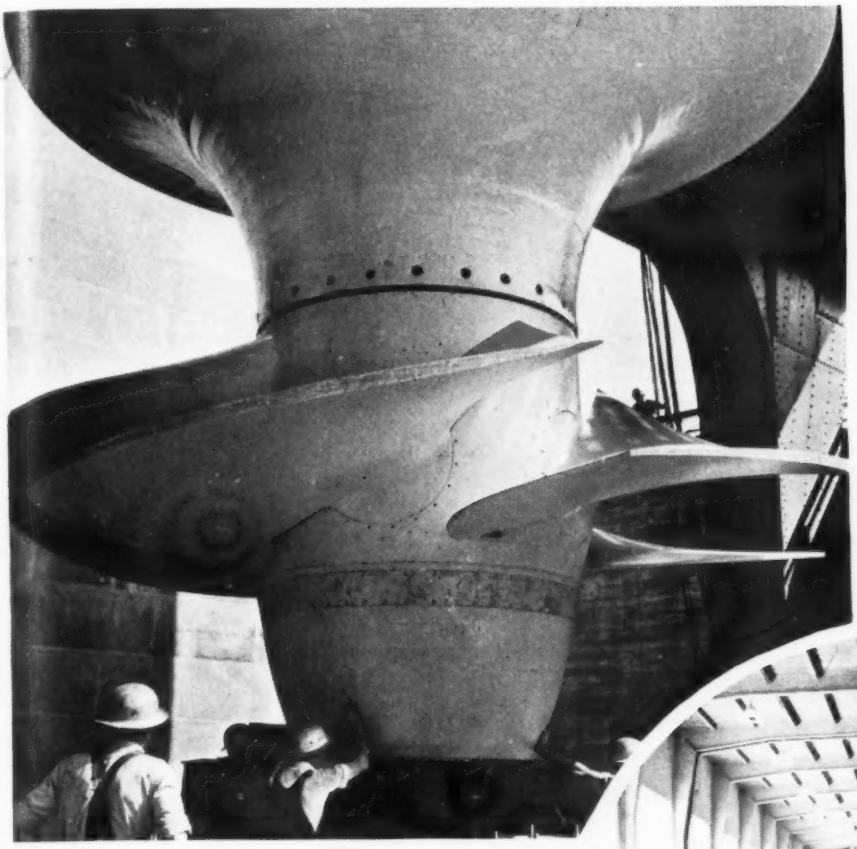
TVA Builds Power Empire (*Continued from page 95*)



Map of the Tennessee River basin shows 28 storage and main-river dams strategically located to impound flood flows in mountainous tributary valleys, later released to maintain flow through main-stream lakes and power-generating plants (South Holston and Watauga not built)

Fontana Dam, 480 ft high, on the Little Tennessee River has two 67,500-kw units and a reservoir with more than 1,100,000 acre-ft of storage for use through eleven hydroelectric plants on the Little Tennessee and the Tennessee Rivers. See the Tennessee River map above





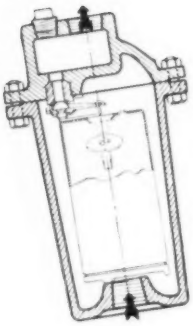
Adjustable-blade propeller runner being installed in one of two 44,000-hp units now in operation in Fort Loudoun Dam plant. This plant with space for four units is the farthest upstream of the TVA main-river dams. It brings the 660-mile navigation channel to Knoxville, Tennessee

Below: These three streamlined generators in Chickamauga power plant on the Tennessee River, are rated 27,000 kw each and are powered by 36,000-hp adjustable-blade propeller turbines operating under a 36-ft head

Below: Guntersville Dam and power plant in Alabama creates a reservoir 82 miles long, extending to the Hales Bar Dam. Besides the navigation channel, the power plant has three 24,300-kw units installed, powered by 34,000-hp turbines operating under a 39- to 45-ft head (*Continued on page* 102)

HOW TO TRAP A LOW PRESSURE HEATING ... for ... and greater ...

Armstrong bottom-inlet, top-outlet style inverted bucket trap.



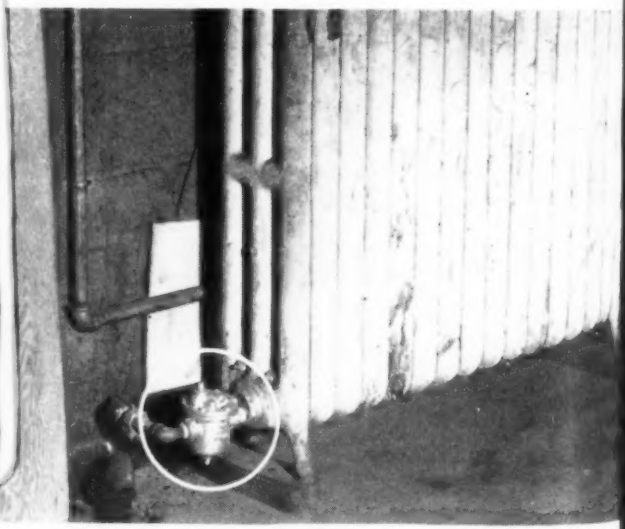
Cross-section of Armstrong Trap. Note simplicity of design.

Side-inlet, side-outlet style. The cap carries the works; the body stays in the line during inspection or repair.

Trapping Tips for Heating Systems*

- **Use one trap for each unit.**
- **Install trap close to and below unit being drained.**
- **Use traps with adequate air venting capacity. (Armstrong traps available to remove 500 to 1500 cu. ft. free air per hour.)**
- **Use traps that discharge condensate at steam temperature with no wait for cooling.**
- **Use high quality traps—any extra first cost will be repaid over and over in reduced maintenance.**

**Ask for Armstrong CATALOG H — 36 pages of tables, data, diagrams on trap selection, installation and maintenance.*



ARMSTRONG · INVERTED BUCKET · STEAM TRAP

ARMSTRONG

Over a Million in Use...

Photo Supply Company Reduces Trap Maintenance 50%; Academy Heats Up Buildings 50% Faster; High School Reduces Coal Consumption 5 Tons Per Day.

Many trap users have found by actual experience that their maintenance costs for so-called low pressure traps on easy heating service were GREATER than for Armstrong Traps on heavy duty high pressure service. Furthermore, records have shown that the extra maintenance costs more than made up for any saving in first cost. It is not surprising, therefore, that these buyers have standardized on Armstrong Traps for all services, with these results:

1. Maintenance costs are sharply cut.
2. Steam leaks have been eliminated.
3. Better performance is secured from steam-heated units.
4. Net trap cost is lower on a yearly basis.

Here are some of the reports:

Defender Photo Supply Co., Rochester, N. Y., put 300 Armstrong Traps on unit heaters, fin coils, etc., and found trap maintenance about half of what it was before.

New York Military Academy heats up buildings 50% faster in the morning since Armstrong Traps were installed.

Springfield, Ohio, high school reduced coal consumption from 9 tons down to 4 tons daily and eliminated need for one boiler—with 30 Armstrongs.

Northwestern Store Equipment Corp., Milwaukee, Wis., reduced coal consumption from 460 tons to 290 tons annually and was able to reduce steam pressure from 10 lbs. to 3 lbs.

Brown Shoe Company, St. Louis, installed 180 Armstrong Traps on coils, unit heaters and header drips after surveying maintenance costs.

Atlanta building reports: "Not one cent for trap maintenance in 10 years."

It pays to buy quality. Armstrong traps don't leak steam; they have adequate automatic air handling capacity; they'll last a long time because of chrome steel valve and seat (hardened, ground and lapped) and stainless steel bucket and valve lever assembly. Nothing to stick, clog or collapse. For any pressure, any vacuum. Sold through leading distributors everywhere. Write for a survey of your plant today. ARMSTRONG MACHINE WORKS, 812 Maple Street, Three Rivers, Michigan.

Inverted Bucket STEAM TRAPS

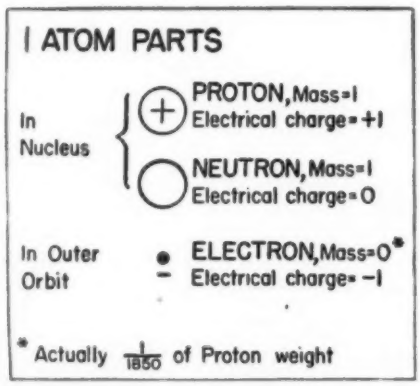
For Power . . . Process . . . Heating

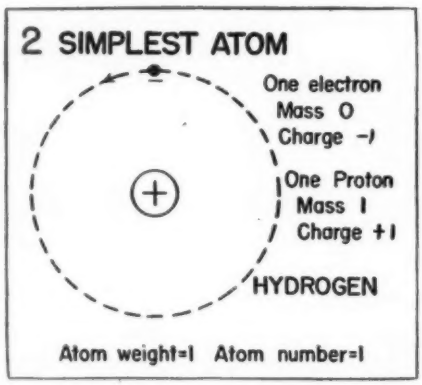
HOW ATOM SPLITTING

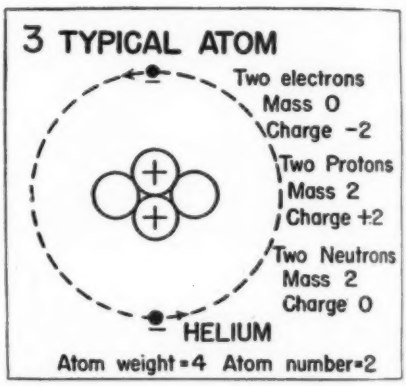
Five years ago the world learned that the atom of Uranium 235 had been split, releasing energy at the rate of about 11,400,000 kilowatt-hours per pound. The whole amount tested was less than the head of a pin, but there was no escaping the possibility that heaters, engines, turbines, jets and explosives could be powered by atomic energy. Then began the race to win the war with atoms.

With what help England could give, America outran the best atom-splitting team Germany could muster. It was all done in silence. From the summer of 1940 until the atomic bomb blasted Hiroshima, black secrecy blanketed history's most amazing scientific and industrial accomplishment.

Coldly scientific in form, the War Department's "Smyth Report," released August 12, 1945, traces

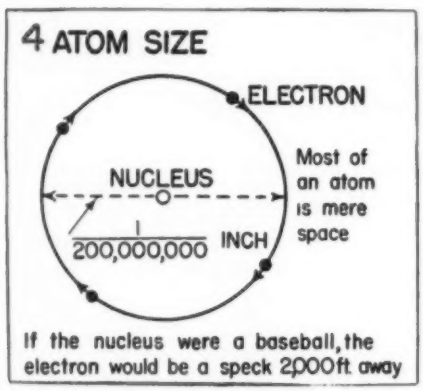


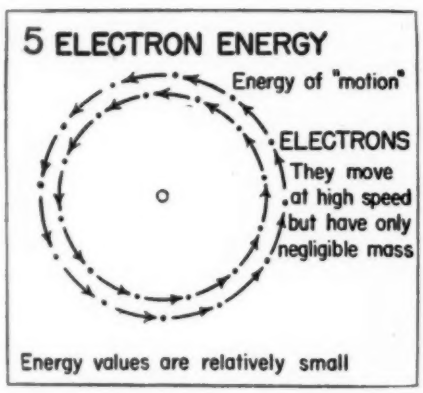


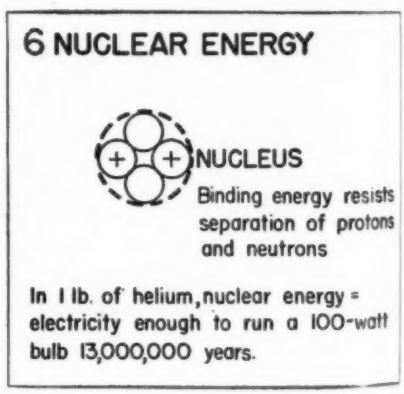


Each of the 92 elements has its own *atom*, yet all atoms are made from the same three pieces, Fig. 1: *proton* (weight 1, electric charge +1), *neutron* (weight 1, charge 0), *electron* (weight 0, charge −1).

Every atom is a tiny "solar system." Its central "sun" has one or more protons, generally neutrons too. The revolving "planets" are electrons, one for each proton in nucleus, because plus and minus must balance in the atom. The opposite charges attract, but high speed keeps the electrons out in their circular orbits, just as the centrifugal tendency of the revolving earth defies the sun's gravitational pull. All the weight of an atom is in the nucleus, so add the number of protons and neutrons to get the atom's weight. The *atomic number* is equal to the number of protons. The elements are known by their atomic numbers. Thus uranium (92 protons) is element 92.


4 ATOM SIZE
ELECTRON
NUCLEUS
Most of an atom is mere space
1/200,000,000 INCH
If the nucleus were a baseball, the electron would be a speck 2,000 ft away


5 ELECTRON ENERGY
Energy of "motion"
ELECTRONS
They move at high speed but have only negligible mass
Energy values are relatively small


6 NUCLEAR ENERGY
NUCLEUS
Binding energy resists separation of protons and neutrons
In 1 lb. of helium, nuclear energy = electricity enough to run a 100-watt bulb 13,000,000 years.

With only their outermost orbits touching, it would take half a million atoms to span the thickness of a human hair. Yet if one could expand an atom until its outer orbits encircled 100 acres, the nucleus would be no bigger than a baseball. The atom is mostly empty space, Fig. 4, and nuclei are difficult targets; so much so that a neutron bullet fired at a mass of atoms may pass right through without a hit.

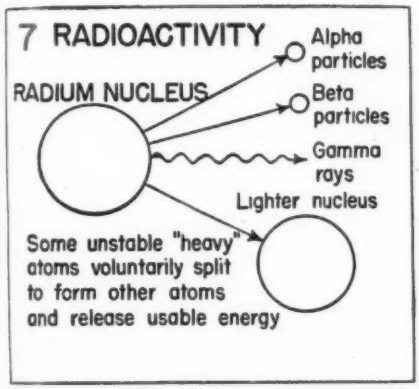
The almost weightless speeding electrons, Fig. 5, supply all the energy of chemical reactions (as when coal burns or TNT explodes). Evading all ordinary chemical action, the immensely greater energy bound up in the nucleus, Fig. 6, can be released only by direct hits on the nucleus to break the bonds that hold the protons and neutrons in a tight bundle.

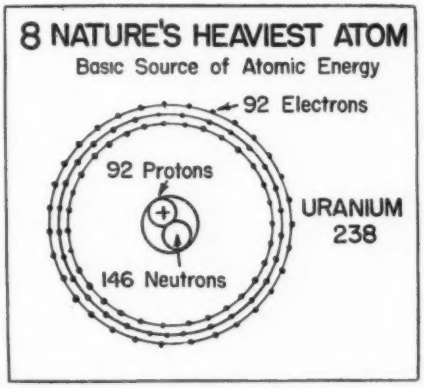
RELEASES ENERGY

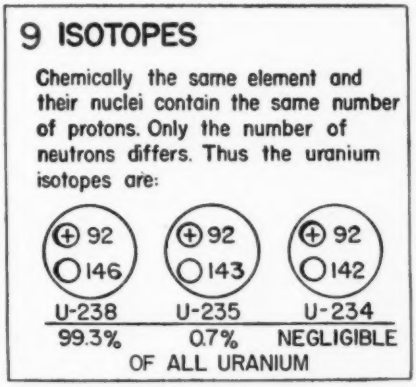
the fantastic course of atomic engineering through the five years of news blackout. It leaves no doubt that only a complete mobilization of America's technical resources could have won this victory in time.

Other writers in other places will unfold the epic story. This presentation leaves no space to reflect the glory of the accomplishment or even to record its history. The aim is more immediately practical — to give the professional and business readers of the McGraw-Hill publications a sound and honest, though non-technical, understanding of this atom-smashing business, so that they will know better what to do about it in their personal and business lives.

Now for step one: learning the shape of atoms and how atom splitting releases energy.

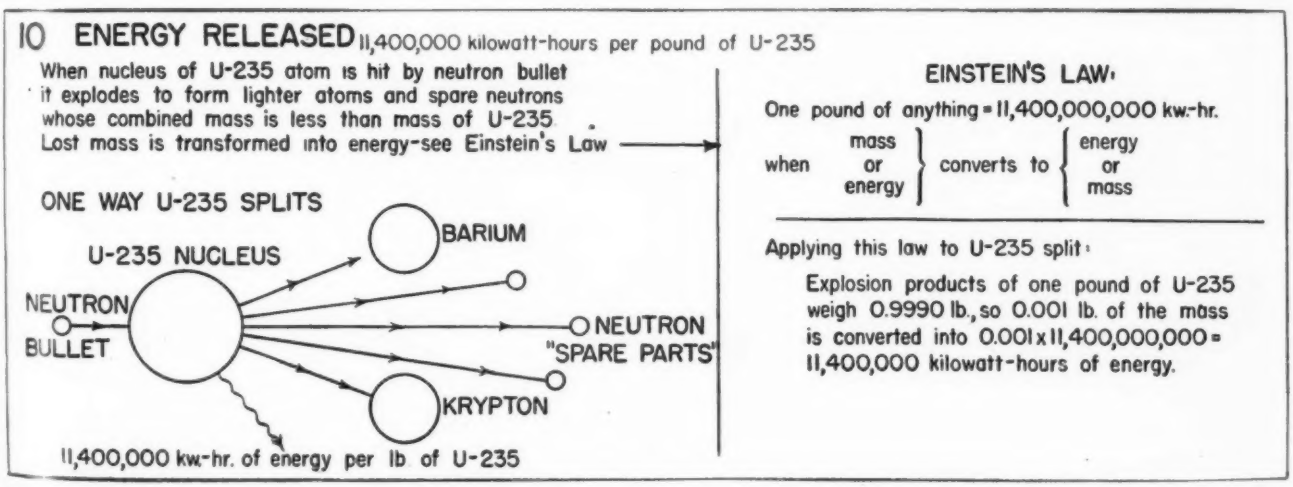






Radium nucleus, Fig. 7, automatically emits particles and energy as it decays to form nuclei of a lighter atom. Most common form of uranium, nature's heaviest atom, is Uranium 238, Fig. 8. This form is not directly useful for energy release, but is important as the raw material for a new synthetic power atom, *plutonium*.

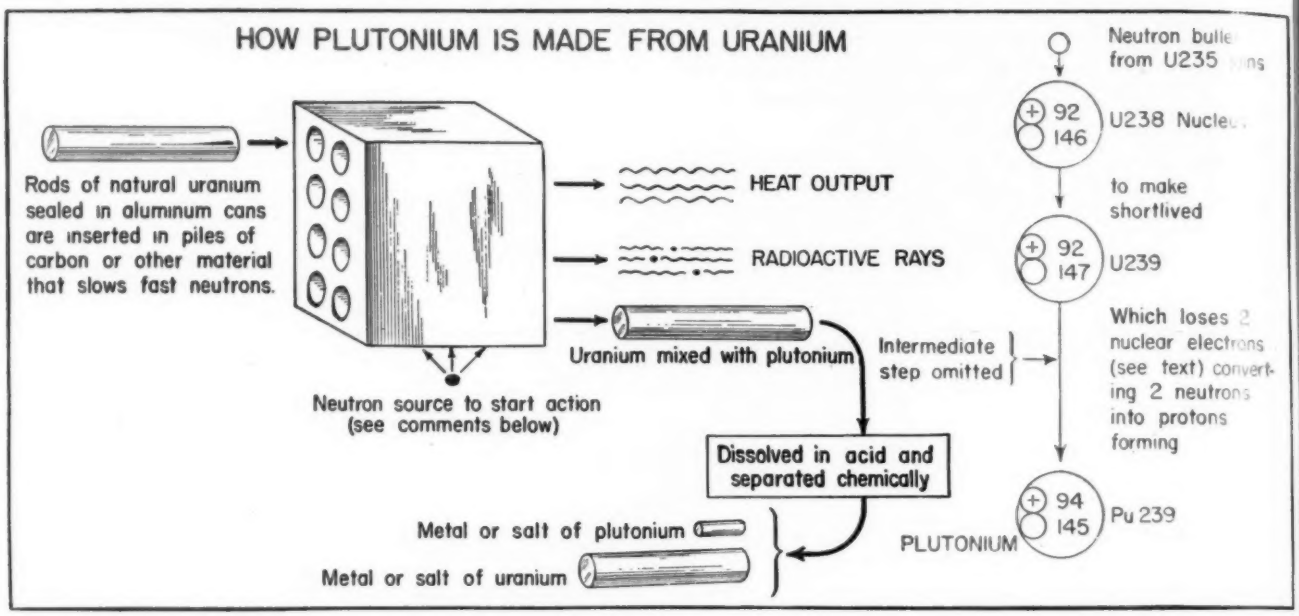
An element may have several *isotopes* — alternate forms with the same number of protons but slightly different numbers of neutrons. Uranium 238 is the isotope in which protons and neutrons total 238 (so atom weight is 238). It is 99.3% of the total weight of pure, natural uranium. The stuff needed for direct atomic-energy release is Uranium 235, only 0.7% of the total weight and very difficult to separate from 238. To put it another way, every pound of energy-giving U-235 comes mixed with a dead load of 140 pounds of relatively inert U-238.


10 ENERGY RELEASED 11,400,000 kilowatt-hours per pound of U-235
When nucleus of U-235 atom is hit by neutron bullet it explodes to form lighter atoms and spare neutrons whose combined mass is less than mass of U-235. Lost mass is transformed into energy-see Einstein's Law
ONE WAY U-235 SPLITS
U-235 NUCLEUS
NEUTRON BULLET
BARIUM
NEUTRON "SPARE PARTS"
KRYPTON
11,400,000 kw-hr. of energy per lb of U-235
EINSTEIN'S LAW:
One pound of anything = 11,400,000,000 kw.-hr.
when mass or energy converts to energy or mass
Applying this law to U-235 split:
Explosion products of one pound of U-235 weigh 0.9990 lb., so 0.001 lb. of the mass is converted into 0.001 x 11,400,000,000 = 11,400,000 kilowatt-hours of energy.

Slow neutron bullet splits Uranium 235 nuclear target, generating two lighter atoms (Fig. 10 shows one possibility) and several free neutrons ready to split other U-235 atoms. The following pages show how the original neutron may be produced and directed and how a chain of self-propagating atomic explosions may sweep through a block of U-235 like a forest fire to release heat energy equivalent to 11,400,000 kilowatt-hours per pound. CONTINUED ON NEXT PAGE

CREATING and ISOLATING

Man-Made Plutonium—U-235 Substitute



We now have two kinds of atoms suitable for energy supply, Uranium 235 and the new man-made element No. 94, plutonium. Uranium, No. 92, has the heaviest atom of any natural element.

The Manhattan Project's plant, on the Columbia River at Hanford, Washington, is the world's greatest atom-making factory. Devoted entirely to the mass production of plutonium atoms, it uses U-238 as the raw material and U-235 as the energy source, intimately mixed in the same proportions as in natural uranium metal.

The production units at Hanford are several huge uranium "piles." Each is a very large block of graphite with holes in which are placed uranium-metal cylinders, sealed in aluminum cans to protect the uranium from corrosion by the cooling water constantly pumped through the pile.

Each pile runs itself, so to speak. Not even the conventionally pictured bits of radium, beryllium and paraffin are needed as a "pilot light" to start operation. There are always enough stray neutrons, or even cosmic rays, to start a chain reaction.

But once started, the design, size and control of the unit must be such that the chain reaction will continue at an even rate — neither die down nor overshoot into an explosion.

To see this picture in atomic terms, consider the fraction of a second in which one million U-235 nuclei are split, producing two million lighter atoms (say, one million of barium and one million of krypton) and between one and three million fast-moving neutron projectiles.

Some of these escape in free flight right through the relatively vast atomic "open spaces." Some are "captured" by the many U-238 nuclei, and others are captured by the impurities. But, on the average, of the one to three million, just one million neutrons must succeed in smashing another million U-235 atoms in the next fraction of a second. Thus, with reproduction rate exactly maintained, life goes on in the atomic-energy pile.

The carbon, one of several possible "moderators," serves to slow down the neutrons without capturing many. The chance of a fast, straight-moving neutron hitting a tiny nucleus is very small, whereas the "slow ball" neutron is likely to be sucked in by the nuclear attraction if it would otherwise be a near miss.

From the practical angle, maintaining a chain reaction requires careful design and good controls. The pile must be slightly larger than actually necessary for a chain reaction (that means scores of tons of material). Controls must be sensitive and dependable. They slow the pile down to the balancing point by sliding in retarders, such as strips of cadmium.

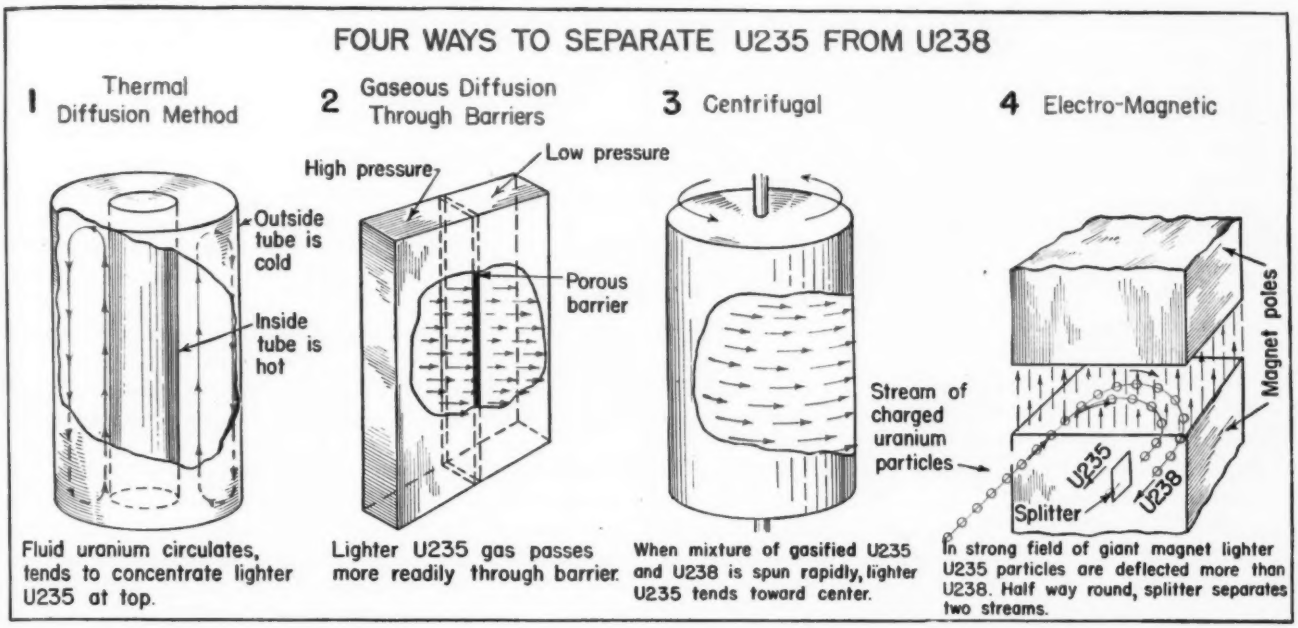
As already noted elsewhere, the energy released is about 11,400,000 kilowatt-hours for each pound of U-235 split. This energy appears first in the high speed of the pieces thrown off by the atomic split, then is converted to sensible heat as collisions slow down these projectiles. The energy is finally removed from the pile in the form of hot air, steam, hot water or other heated fluid in commercial quantity and thermal condition.

Such piles, operated with normal uranium, or with uranium enriched in U-235, would seem to be the primary means by which atomic energy will serve (if ever) as a commercial source of heat and power. Plutonium would be a byproduct, but might under certain conditions add to the energy yield of the pile without the need to separate it from the uranium.

The use of normal uranium in the Hanford pile sounds extremely attractive as a heat source, but has certain economic disabilities. Only a small part of the U-235 is used up before the pile must be shut down to remove the plutonium.

THE HIGH-POWER ATOMS

Isolating U-235 — a Gigantic Task


FOUR WAYS TO SEPARATE U235 FROM U238
1 Thermal Diffusion Method
2 Gaseous Diffusion Through Barriers
3 Centrifugal
4 Electro-Magnetic
Outside tube is cold
Inside tube is hot
High pressure
Low pressure
Porous barrier
Stream of charged uranium particles
Magnet poles
U235
U238
Splitter
Fluid uranium circulates, tends to concentrate lighter U235 at top.
Lighter U235 gas passes more readily through barrier.
When mixture of gasified U235 and U238 is spun rapidly, lighter U235 tends toward center.
In strong field of giant magnet lighter U235 particles are deflected more than U238. Half way round, splitter separates two streams.

Many of the uranium ores, including most samples of pitchblende and carnotite, will yield from 1 to 15% metallic uranium. Chemical separation of the metallic "natural" uranium is simple. Whatever the source, natural uranium contains the three isotopes in the constant proportions of 99.3% U-238 and 0.7% U-235, with traces of U-234.

Separating the U-235 from U-238, an operation essential for explosive uses of U-235, and probably important for future commercial controlled-chain piles, has been most difficult. Chemical separation was impossible because U-235 and U-238 are chemically the same.

The only possibility was a separation by physical differences, primarily a one percent difference in weight. The porous barrier and centrifugal methods pictured above required vaporizing a salt of uranium. All the methods shown have been used or tried on the Manhattan Project. All require many stages to achieve a substantial concentration of Uranium 235.

Dollarwise Thoughts on Atomic Energy

Costs mean little in war, but peacetime uses of U-235 and plutonium must pass the dollar test in competition with coal, fuel oil, natural gas, gasoline and electricity.

On the basis of energy costs only, "*all other things being equal,*" the table on the last page of this section shows at what price per pound U-235 would give the same energy cost as conventional energy sources selling at the indicated prices. For such comparisons it is convenient to remember that one pound of U-235 is equal (energy-wise) to about 11,400,000 kilowatt-hours, also to 1500 tons of coal, or 200,000 gallons of gasoline.

Fuel engineers understand the limitations of such oversimplified comparisons. Others should be warned that "all other things" are never equal. With this thought in mind, reconsider the uranium piles operated at Hanford to produce plutonium. These use U-235 in the cheapest form, say about $1400 per lb., assuming purified normal uranium at $10 per lb. (140 lb. of uranium contains one pound of U-235.)

If this were the whole story, coal would have to sell for a dollar a ton to break even with U-235 as a water heater. However, the pile using normal uranium must be immense to hold its own in a chain reaction. More important, the accumulating fission products "poison" the reaction after only a small part of the U-235 has been used up. Then the uranium cylinders must be removed for plutonium recovery. Finally, it has not yet been found possible to operate the normal-uranium piles at high enough temperatures for practical power production.

If we go to the other extreme and build a small pile, using concentrated U-235, we shall run into excessive material costs, perhaps several times the $52,000 per lb. set down in the table as the equivalent of 20-cent gasoline.

Something between the two extremes is likely to prove the most economical — perhaps a pile operating on a U-235 concentration between 1 and 10%.

The engineer of the "atomic-power age" must know the price of Uranium 235 *in various concentrations* and the characteristics of piles suited to them. No such information is yet available. He must also watch the danger from radio-activity; the requirements for radiation shields; explosion hazards, etc.

CONTINUED ON NEXT PAGE

WHAT TO EXPECT

Before discussion of possible and probable future applications of atomic energy to the arts of peace, the atomic bombs should have consideration. We may assume that these bombs contained from two to 200 lb. of either U-235 or plutonium, or both. No more precise information is available.

Details of the bomb design have been completely suppressed, but the following basic considerations are stated or implied in the Smyth Report:

The explosive in a bomb must be highly concentrated U-235 or plutonium. Since slow neutrons could not produce a satisfactory explosion, the neutron retarder or *moderator,* is minimized. This, in turn, requires a U-235 mass so large that the escape of neutrons without hitting nuclei will not be excessive. For every 1000 atoms hit, the neutrons produced must split more than 1000 new atoms, so that the reaction will proceed rapidly in an expanding chain, as sketched below.

There can be little leeway in the size of the explosive charge. For a given shape there is a certain "critical" weight of material. If this is exceeded the bomb explodes instantly. If the weight of charge is less than the critical, it cannot be made to explode.

Therefore, the critical mass must be created at the moment of explosion.

The Smyth Report suggests that this can be accomplished by breaking down the charge into two or more well-separated parts, each having less than the critical mass. At the appointed moment these could be brought together within the bomb to create a supercritical mass, which would then explode automatically.

CLAIMS LIKE THESE ARE NOT JUSTIFIED

1. Pretty soon no more coal will be mined except as a raw material for chemical manufacture.

2. In a few years a tiny bit of uranium, built in at the factory, will drive your car for life through an engine no bigger than your fist.

3. All the big central stations will soon be running on atomic power.

4. Cheap atomic energy will enormously reduce the price of power.

Peacetime Applications

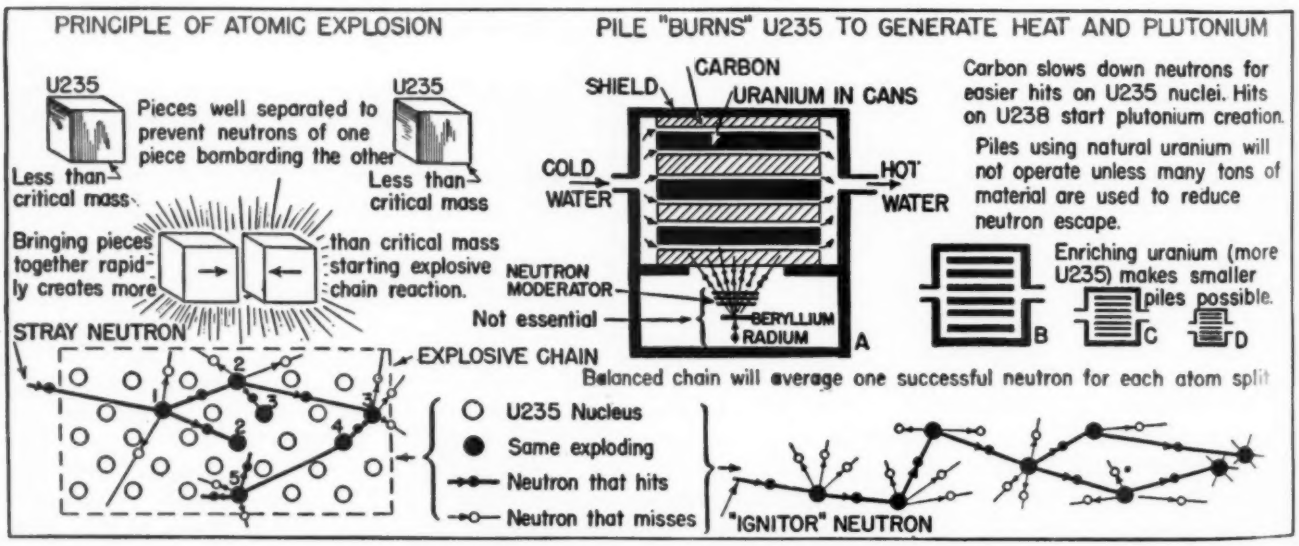
Except possibly for superblasting operations, uncontrolled explosive reactions cannot be permitted in the peacetime use of atomic energy. This means that the quantity of U-235 assembled in any one spot must always be kept well below the critical weight to avoid spontaneous explosion.

Depending on the particular application, the most desirable concentration of U-235 may range anywhere from the 0.7% in normal uranium up to 100%, with the probability that many industrial applications will find the greatest economy in concentrations between 1% and 15%.

This matter of the degree of concentration of U-235 has received little public attention, yet nothing could be of greater practical importance. To make this point clear, consider the two extremes, 0.7% of U-235 and 100% of U-235, respectively.

The Hanford pile, using normal uranium (0.7% U-235) with carbon moderator, must be very large to work at all. It is inefficient in the sense that it must be shut down after a small part of the U-235 has been consumed. It cannot operate at high temperatures.

Its great advantage as a heat producer is the fact that its U-235 is bought at the lowest possible price. If


PRINCIPLE OF ATOMIC EXPLOSION
U235
U235
Pieces well separated to prevent neutrons of one piece bombarding the other
Less than critical mass
Less than critical mass
Bringing pieces together rapidly creates more than critical mass starting explosive chain reaction.
STRAY NEUTRON
EXPLOSIVE CHAIN
PILE "BURNS" U235 TO GENERATE HEAT AND PLUTONIUM
CARBON
SHIELD
URANIUM IN CANS
COLD WATER
HOT WATER
NEUTRON MODERATOR
Not essential
BERYLLIUM
RADIUM
A
Carbon slows down neutrons for easier hits on U235 nuclei. Hits on U238 start plutonium creation.
Piles using natural uranium will not operate unless many tons of material are used to reduce neutron escape.
Enriching uranium (more U235) makes smaller piles possible.
B
C
D
Balanced chain will average one successful neutron for each atom split
U235 Nucleus
Same exploding
Neutron that hits
Neutron that misses
"IGNITOR" NEUTRON

FROM ATOMIC ENERGY

. . . BUT REMEMBER THESE FACTS

1. The large-scale, controlled release of heat energy from U-235 has been fully demonstrated.

2. Beyond question, this energy could be applied directly for heating water and air, and making steam.

3. Such heat, in turn, could be applied directly, or converted into mechanical power or electricity by conventional steam turbines and gas turbines.

4. If and when U-235 in concentrations up to 10% costs less than $25,000 per lb., it may find applications, but will compete, at first, with premium fuels rather than coal.

purified normal uranium sells for, say, $10.00 per lb., the price of 140 lb. (containing one lb. of U-235) will be only $1400. This would be a very favorable price if the pile could operate efficiently with the 0.7% U-235.

Concentrating the U-235 to 100% would permit a much more compact and convenient pile — perhaps little more than small pieces of U-235, encased in aluminum to ward off corrosion, and immersed in a tank of water; this should convert the water into steam at a regulated rate.

In large part, the control would be inherent. The water as a moderator would keep the chain going, but if the reaction got too violent, the resulting higher superheating of the steam would decrease the moderator effect and thereby hold the reaction in check. Yet even if all this comes true the cost of concentrated U-235 in the near future will be many times $10,000 per lb.

Running up the concentration only a few percent above that in normal uranium may prove to be the way to get reasonable pile size and good efficiency without incurring exorbitant concentration costs.

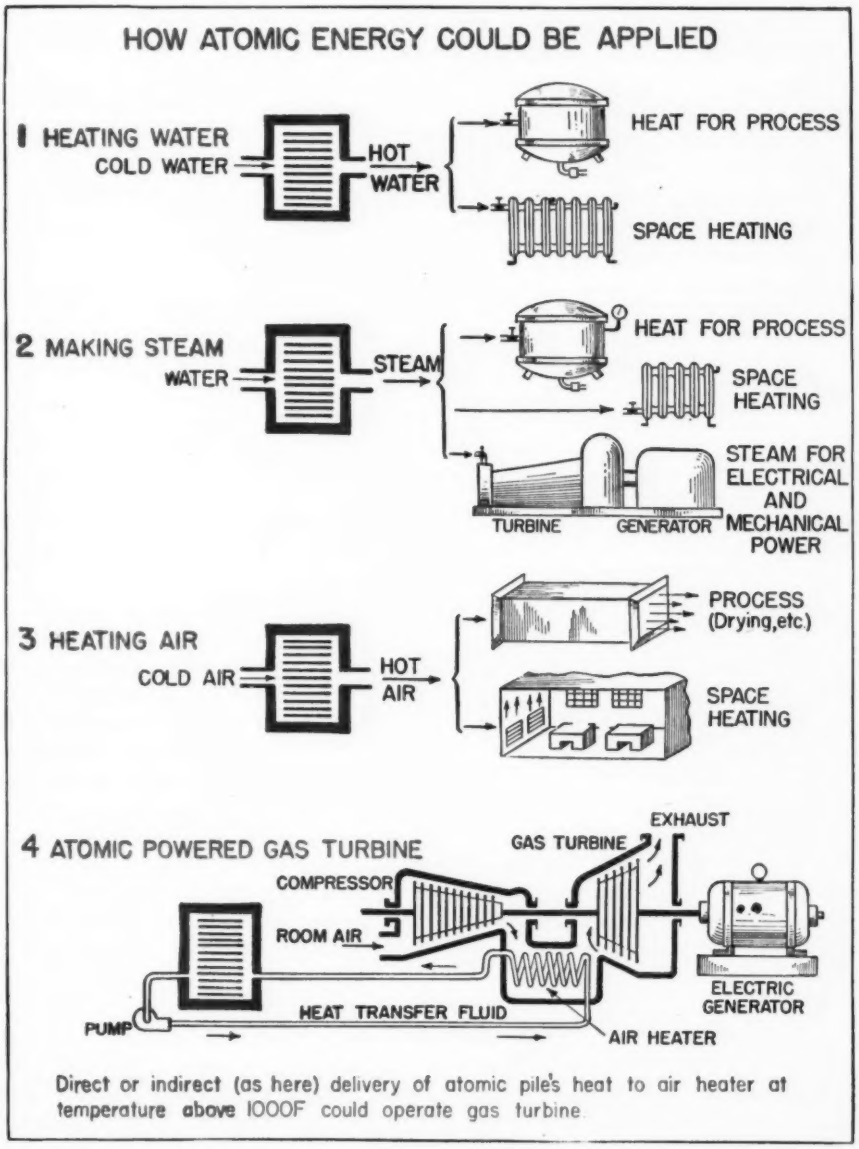
When atomic energy is applied, the starting point is heat, picked up by water, air or a special heat-transfer fluid. Intermediate heat transfer fluids may be essential in certain applications (space heating and service water, for example) where people must be protected from injury by radioactivity.

The intermediate heat-transfer fluid shown for the gas turbine would, of course, have to operate at temperatures up to 1200 F. There seems to be no basic reason why the pile itself could not be built inside the compressed-air receiver, discharging its heat directly to the compressed air.

With rather high concentration of U-235, this arrangement might be suitable for large airplane drive if excessive weight of radiation shields could be avoided.

Also, presumably, rockets and planes of the "buzzbomb" type could be powered by atomic heat delivered to the air of the jet steadily, not in puffs.

The sketches stress direct applica-



Direct or indirect (as here) delivery of atomic pile's heat to air heater at temperature above 1000F could operate gas turbine

THESE THINGS MIGHT RESTRICT USE OF ATOMIC ENERGY

1. Ineffectiveness of large piles using normal U-235 concentration
2. High cost of concentrated U-235 for smaller, more effective piles
3. Danger from radioactivity
4. Weight and cost of shielding against radiation
5. Explosion hazard
6. Possible short supply of uranium
7. Governmental restrictions on atomic-energy materials

tions of hot air, steam and hot water to process and space heating. This emphasis is justified by the often overlooked fact that such applications of heat have many times the total energy value of all the electricity generated in the United States for all purposes.

There has been much popular speculation regarding the type of engines required for atomic-power generation. The answer is simple. Present engines, steam turbines and gas turbines can be used with little or no change. This, of course, does not rule out the possible discovery of specialized engines for atomic power, or even direct production of electricity from atomic energy.

In the long run the implications of atomic power are staggering for both war and peace. However, popular writers on the subject have undoubtedly created unreasonable hopes in the minds of readers — for example, the expectation that in two or three years the Detroit builders will market cars with built-in "lifetime" slugs of U-235 and "fist-sized" engines.

Yet it seems fairly safe to predict that atomic energy will find some commercial applications within the next five or ten years, first, probably, as a premium fuel like aviation gasoline, worth a fancy price for specialized applications where low weight or some other characteristic is important.

As the cost of concentrating U-235 is reduced and application efficiencies improved, atomic energy may compete with cheaper fuels, perhaps ultimately with coal.

Important non-power applications of atomic energy may well include the ultra-high-temperature processing and fabricating of materials — also, modern "alchemy": building and rebuilding atoms to create new elements and to produce old elements at lower costs.

Radioactivity obtained directly or indirectly from artificial atom-splitting should find many important medical and industrial applications.

Turning back to ordinary power applications, we must avoid the temptation to overstress the economic importance of lower-cost power fuel. Fuel cost is only about 17% of the gross receipts of the electric utilities. Here's another way to put it: If, after allowing for transmission losses, one kilowatt-hour delivered to the consumer from modern plants represents a coal consumption of 1.5 lb., and if the coal costs $5.00 per ton cancellation of the coal bill could not save more than ⅜ of a cent per killowatt-hour. And atomic fuel will certainly not be free.

Performance of the atomic bomb is a monument to the scientists who unlocked the secrets of the atom and suggested the basic technique of making plutonium and concentrating U-235.

From there on, the job was at least 50% engineering. The various big plants of the Manhattan Project are vast assemblages of pipes, tanks, boilers, valves, instruments and controls, installed and operated by engineers, largely designed by engineers. From now on, the speed with which atomic power becomes practical will depend on the effectiveness of the engineer-scientist team.

It is possible, of course, that national controls may completely upset the entire technical and economic pattern of this discussion. For reasons of national security the government may decide to control or restrict atomic-power materials, plants and operations in ways not yet determined.

U-235 COULD COMPETE AT THESE PRICES

other things being equal

Common fuel	*Assumed prices*	*Comparable prices for Uranium 235, dollars per pound (nearest thousand)*
COAL (13,000 B.t.u.)	$6 per ton	$9,000
	$12 per ton	$18,000
	$15 per ton	$23,000
FUEL OIL (150,000 B.t.u. gal.)	2¢ per gal.	$5,000
	4¢ per gal.	$10,000
	8¢ per gal.	$20,000
CITY GAS (500 B.t.u.)	50¢ per 1000 cu. ft.	$39,000
	$1 per 1000 cu. ft.	$78,000
NATURAL GAS (1000 B.t.u.)	25¢ per 1000 cu. ft.	$10,000
	50¢ per 1000 cu. ft.	$20,000
	$1 per 1000 cu. ft.	$40,000
GASOLINE (150,000 B.t.u. gal.)	10¢ per gal.	$26,000
	20¢ per gal.	$52,000
	30¢ per gal.	$78,000

BUT

Note that "other things" are never equal. U-235 in normal uranium form is by far the cheapest, but involves use of excessively large and inefficient "piles." The unit cost of the U-235 in enriched mixtures increases with the degree of enrichment. Over-all cost comparisons can be made only for a specified concentration of U-235 and for apparatus suitable for that particular concentration. Possible explosion danger and need to protect personnel against radiation are other important considerations.

For Long Life: Fit Fluorescent-Lamp Characteristics to the Power Supply

Unlike incandescent lamps, fluorescent units are extremely sensitive to voltage and frequency values either above or below their design range. Select units with characteristics that most nearly match those of the local power source

BY ROBERT R WYLIE
Commercial Engineer
Sylvania Electric Products, Inc

▶FIRST REQUIREMENT of any lighting system is that it operate from the exact power supply for which the light sources are designed. With incandescent lighting, the effects of voltage variations are relatively well known. Whether the supply voltage is dc or ac of 25, 50, 60 or 1000 cycles, operating characteristics are not affected, aside from objectionable flicker at low frequencies (up to 30 cycles per sec).

With gaseous-discharge lamps, however, proper voltage, frequency and other optimum conditions are imperative for best operation. If the power supply conforms to the rating of the control equipment, it will deliver the correct current and voltage to the lamp.

Control equipment is available over several voltage ranges, such as 110 to 125, 194 to 220, 220 to 250, and 254 to 277 v. Equipment and light source operate at greatest efficiency at one point in each range, namely, 118, 208, 236 and 260, respectively. Similarly, the control equipment is designed for different power frequencies. There are ballasts available for 25, 40, 50, 60, 143, 180, 400 and 800 cycles. Satisfactory operation can be expected if the deviation is not more than plus or minus 4% from the optimum values outlined above. Fig. 1 shows effect of voltage variations on fluorescent ballasts and lamps.

Voltage supply higher than the maximum limit shown on the ballast causes it to overheat and possibly burn out.

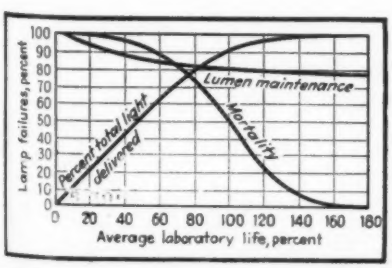


Fig. 2—Fluorescent lamp mortality rate and light output characteristics

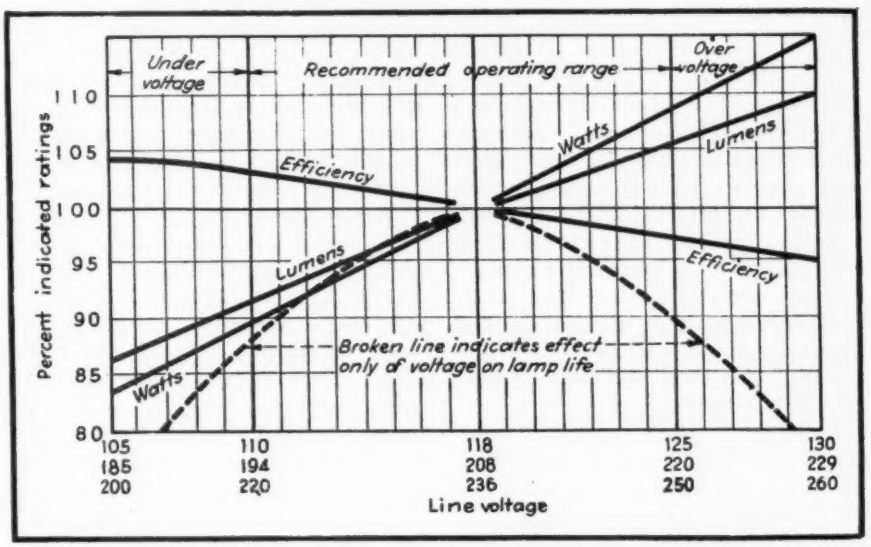


Fig. 1—Effects of voltage variations on life, light output, watts and efficiency of fluorescent lamps. Keep voltage variation within plus or minus 4%

Also, too much current is delivered to the lamp, blackening it and causing early failure. This is analogous to overvoltage operation of an incandescent lamp. Added to these difficulties, the arc column may snake or spiral and thus produce an unpleasant visual effect.

If voltage is below minimum rating, starting current may be too low to preheat the cathodes properly and if the lamps operate at all, they flash off and on, thereby shortening useful life. On a 2-lamp ballast under low-voltage conditions, the lamps' light output is generally unequal because current in the inductive circuit drops off faster than that in the capacitive side. This generally occurs where the voltage is on the border line between flashing and correct operation, but still under recommended range.

Circuit of any gaseous-conduction lamp usually contains not only inductance but also capacitance and it is, therefore, a single-frequency device. If the ballast operates at too high frequency, there is little or no damage to the control equipment. Thus, a ballast designed for 60-cycle current may operate at higher frequency, up to 75 or 80 cycles, without changing its characteristics. However, light output decreases. If a ballast operates at too low frequency the magnetic circuit becomes greatly overloaded, and the operating current delivered to the lamp rises to an abnormally high value, which soon injures not only the lamp but the ballast.

Therefore, one prime factor in good lighting maintenance is good auxiliary equipment that agrees exactly with the power source. If the operating voltage can be brought to the optimum values above, results are even better. Federal specifications outline limits for permissible current and voltage that should be delivered to a lamp. If these factors are correct and the lamp properly designed, the system should operate efficiently.

Next consider the light source itself.

It should meet certain specifications for permissible current density and starting and operating voltage. Lamp design and care in manufacture govern these factors. If a lamp has too high an operating voltage, ionization potential of the starter aproaches that of the lamp. The starter may cut in and out of the circuit, causing the lamp to flash off and on and thus give short life. Lamps with too high gas pressure tend to have this characteristic. Also, cathodes must be able to carry the preheat current as well as the operating current, or they fail early in life. Conversely, a cathode that is too rugged will not provide enough ionizing current and the lamp will not operate. The table shows average lamp life.

Planned Cycling Table

Average Lamp Life

Burning hours per start	*Life in hours* 15–40 watt	100 watt
3	2500	3000
6	4000	4500
12	6000	6500

Judge lamp performance by above fluorescent-lamp life ratings, which closely simulate actual operating conditions.

Average Lamp Life

Average life means the average for a large group of lamps burned under specified conditions; that is, some lamps burn out early whereas others last well beyond rated life. Fig. 2 and 3 explain *rated average life.* These curves represent some of the salient features for appraising over-all life and light output of fluorescent lamps under controlled laboratory conditions, and are representative of a large well-designed fluorescent installation.

Examination of the mortality curve shows that at 100% average laboratory life about 50% of the lamps will have failed. While this deterioration in total light output is taking place there is a further depreciation of total light intensity from aging of the light source. (See lumen-maintenance curve.) Therefore, as the total initial installation burns towards complete failure a greater and greater proportion of the total light output that can be delivered from the original lamp decreases. (See percent total-light-delivered curve.) Therefore as the burning hours of a large installation approach lamp rated life, percentage of useful light yet to be delivered becomes progressively smaller.

On this basis it is economically sound to group-replace lamps and maintain fixtures near *average-rated-life* point. A safe rule: Group maintenance is economically sound when light intensity drops to 70% of initial intensity. (Initial intensity for fluorescent occurs at 100 hr.) Naturally, rate of dirt accumulation affects cleaning frequency, but not necessarily replacement frequency.

Fig. 3 is useful in determining average annual number of expected replacements in a fluorescent installation. Chart indicates directly number of expected replacements for lamps operated according to the planned cycling table. Divide these figures by suitable factors to get replacement rate for periods other than a year.

For example, assume that 450 100-watt lamps are operating 15 hr per day, five days a week on a 6-hr cycle. Under these conditions, average rated life of 100-watt lamps is 4500 hr. Start at upper left-hand corner with burning hours per day (15), proceed downward to number of operating days per week (5), then horizontally to the right to line marked 0-100. Proceed diagonally toward the zero point in upper right-hand corner to the intersecting line for total number of lamps in installation. Extend a line horizontally from this intersecting point into the rated average-life column at right. For lamps having a rated average life of 4500 hr, 390 would have burned out at the end of a year. This is about 33 per month.

Chart Is Adaptable

Using the number (450) of lamps simply shows that by multiplying or dividing by 10, depending upon the number of installed lamps, you obtain directly the expected burnouts for multiples of the indices given in the number-of-lamps-in-the-installation column—45 lamps burning under the same conditions produce 39 failures per year.

If only lamp-operating hours and cycling period, such as 3900 hr per year, are known, start at the left of the chart, proceed directly to the 0-100 index line, and arrive at the same answer.

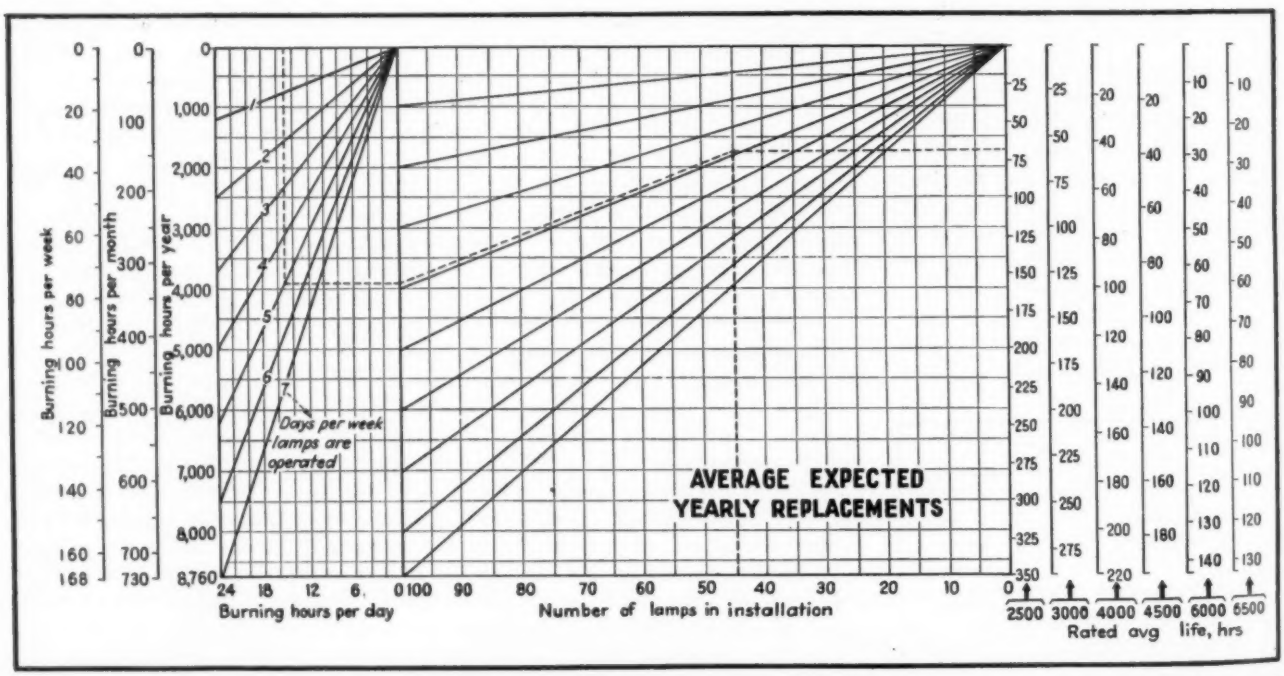


Fig. 3—Chart shows the average annual number of expected lamp replacements. Divide by a suitable factor to get the rate for periods less than a year and to bring the total number of installed lamps within range of the chart

Combustion Data In Convenient Form

Useful basic information in terms of weights, volumes and mols for combustible elements and compounds—also for oxygen, air and the various products of combustion

By PHILIP W SWAIN, EDITOR

▶THE TABLES AND EXAMPLES here and on page 106 first appeared as part of my much longer article, "Fuels & Combustion" (Feb, 1944 POWER, pp 76-81). They are repeated for convenient reference and wider use, and also to permit new and more legible spacing in the tables.

One mol of any element or compound is a quantity in pounds *numerically* equal to the molecular weight. Molecular weight of carbon is 12, of oxygen 32, and of water 18; so a mol is 12 lb of carbon, 32 lb of oxygen, 18 lb of water, and so on. Note that the foregoing applies to *any* chemical element or compound (gas, liquid or solid) and that *weight* of the mol is not affected by pressure, temperature or anything else.

Weight of a mol depends on the substance. On the other hand, *volume of a mol does not depend on the substance* if it is a perfect gas. This holds closely for all gases (except water vapor) involved in ordinary combustion problems. Thus, at any given pressure and temperature, 32 lb of oxygen fills the same space as 44 lb of CO_2, 16 lb of methane, etc. For standard conditions of 60 F and 14.7 psi abs this common value of the mol is 379 cu ft.

Knowing this, it is easy to get the weight of a cubic foot of any gas at standard conditions. For example, we know that one mol (44 lb) of CO_2 at 60 F and 14.7 psi abs fills 379 cu ft, so the weight per cubic foot must be 44 ÷ 379 = .1161 lb. Check this with value in table below, "Combustion Products."

To change mols into pounds, multiply by the molecular weight. To change pounds into mols, divide by the molecular weight.

However, most combustion problems involving mols make no use whatever of the number 379. The important thing to remember is that gas volumes are directly proportional to mols. Thus, 100% by volume of any gas mixture may be taken as 100 mols. Then 5% becomes 5 mols; 14% 14 mols, and so on. This relationship is used for the flue gas in the attached coal combustion example and for both fuel and flue gas in the natural-gas problem.

After figuring the atmospheric oxygen used in combustion it is often desired to see how much air or nitrogen this involves. Here are the conversion factors based on the fact that air is 21% oxygen by volume and 23% by weight:

Volume air = volume oxygen ÷ 0.21

Weight air = weight oxygen ÷ 0.23

Nitrogen (vol or wt) = air − oxygen

(*Continued on page* 106)

The Weight and Volume of One Mol

379 cu ft of any gas at 14.7 psia and 60 F equals one mol. Weight of one mol, in lb, equals molecular weight

Substance	Formula	Molecular weight	Weight of 1 mol, lb	Volume of 1 mol, mol unit of volume (not cu ft)	State at room temperature
Carbon dioxide	CO_2	44	44	1	Gas
Carbon monoxide	CO	28	28	1	Gas
Hydrogen	H_2	2	2	1	Gas
Oxygen	O_2	32	32	1	Gas
Nitrogen	N_2	28	28	1	Gas
Methane	CH_4	16	16	1	Gas
Ethylene	C_2H_4	28	28	1	Gas
Ethane	C_2H_6	30	30	1	Gas
Air		29	29	1	Gas
Carbon	C	12	12	*	Solid
Sulphur	S	32	32	*	Solid
Water	H_2O	18	18	**	Liquid

* Don't attempt to use for solids the volume rule for one mol of gas. Solid volumes run very much less and usually are not considered.

** At high temperature, H_2O is superheated steam, in which one mol is about one volume. This does not hold for combustion products at room temperature. Before an orsat analysis H_2O condenses out, so H_2O volume for gas-analysis purposes is taken as zero.

Combustion Products and Common Combustibles

Substance	Formula	Molecular weight	At 14.7 psi abs and 60F: Weight lb per cu ft	At 14.7 psi abs and 60F: Volume, cu ft per lb	Nature: Gas or solid	Nature: Combustible	Heating value, Btu: Per lb	Heating value, Btu: Per cu ft at 14.7 psi abs & 60 F	Heating value, Btu: Per mol
Carbon	C	12			S	C	14,500		174,000
Hydrogen	H_2	2	.00528	189.5	G	C	61,000	322	122,000
Sulphur	S	32			S	C	4,000		128,000
Carbon monoxide	CO	28	.0739	13.54	G	C	4,350	321	122,000
Methane	CH_4	16	.0422	23.69	G	C	23,900	1008	382,000
Ethylene	C_2H_4	28	.0739	13.54	G	C	21,600	1596	605,000
Ethane	C_2H_6	30	.0792	12.63	G	C	22,300	1766	669,000
Oxygen	O_2	32	.0844	11.84	G	No	.....	.....	.....
Nitrogen	N_2	28	.0739	13.54	G	No	.....	.....	.....
Air		29*	.0765	13.07		No	.....	.....	.....
Carbon dioxide	CO_2	44	.1161	8.61	G	No	.....	.....	.....
Water	H_2O	18				No	.....	.....	.....

* Molecular weight of air is weighted average of molecular weights of oxygen and nitrogen.

Values above differ slightly from those in other reference books, but difference is generally less than 1%. For internal consistency, this table is based first on generally accepted heat values, rounded as indicated. From these and listed molecular weights, all other data were computed on assumption that all gases tabulated are perfect and that volume of one mol is 379 cu ft at 60 F and 14.7 psi.

Combustion Data in Convenient Form

(*Continued from page* 105)

Example of Combustion of Natural Gas

Given volumetric analysis of a natural gas. To determine the volumetric analysis of the flue gas if the fuel is burned with 40% excess air (by volume):

(1) Gas analysis by volume, %

CO	0.60
H_2	1.62
CH_4	94.30
C_2H_6	0.15
H_2S	0.25
O_2	0.40
CO_2	0.85
N_2	1.83
Total	100.00

(2) Oxygen, combustion products for 100 mols of fuel

Gas	Mols	Mols O_2 needed	Mols produced CO_2	H_2O	SO_2
CO	0.60	0.30	0.60	.....	.....
H_2	1.62	0.81	.....	1.62	.....
CH_4	94.30	188.60	94.30	188.60	.....
C_2H_6	0.15	0.45	0.30	0.30	.....
H_2S	0.25	0.37	.....	0.25	0.25
CO_2	0.85	.....	0.85	.....	.....
Total	.....	190.53	96.05	190.77	0.25
Minus O_2 in fuel	.....	0.40	.....	.....	.....
	.....	190.13	96.05	190.77	0.25

(3) Figuring nitrogen in flue gas

N_2 required for 190.13 mols O_2 = 190.13 × 3.76 = 714.9 mols
40% excess N_2 (by volume) = 0.4 × 714.9 = 286.0
N_2 in fuel = 1.8
N_2 in flue gas = 1002.7 mols

(4) Unburned O_2 in flue gas = 0.40 × 190.13 = 76.0 mols

(5) Volumetric gas analysis (H_2O disappears)

Gas	Mols	% by Vol
CO_2	96.1	8.2
O_2	76.0	6.5
SO_2	0.2	0.0
N_2	1002.7	85.3
Total	1175.0	100.0

Example of Coal Combustion

Given complete analysis of coal and flue gas. To determine (per lb coal) theoretical air, actual air, dry flue gas, moisture in flue gas—also % excess air and % loss from incomplete combustion.

(1) Ult analysis of coal (as fired), % by weight

Ash	10.49	
Sulphur	1.20	
Hydrogen	6.47	
Carbon	71.98	
Nitrogen	1.16	
Oxygen	8.70	100.00%
Btu per lb	13,800	

(2) Flue-gas analysis, percent by volume

CO_2	10.2	
CO	0.6	
O_2	9.2	
N_2	80.0	100.00%

(3) Figuring mols of carbon and nitrogen in flue gas

Flue Gas	%	Mols Gas	Mols C	Mols N_2
CO_2	10.2	10.2	10.2	....
CO	0.6	0.6	0.6	....
O_2	9.2	9.2	....	....
N_2	80.0	80.0	....	80.0
Total mols	....	100.0	10.8	80.0

(4) Weight carbon burned = 10.8 × 12 = 129.6 lb
(5) Weight coal burned = 129.6 ÷ 0.7198 = 180.0 lb
(6) Mols air supplied = 80.0 ÷ 0.79 = 101.3
(7) Weight air supplied = 101.3 × 29 = 2938 lb
(8) Ratio air to coal = 2938 ÷ 180.0 = 16.32 lb air per lb coal
(9) Moisture produced per lb coal = 0.0647 × 9 = 0.58 lb
(10) Dry flue gas per lb coal = coal + air − ash − moisture = 1 + 16.32 − 0.1049 − 0.58 = 16.64 lb

LOSS IN CO

(11) Fraction carbon burning to CO = 0.6 ÷ (10.2 + 0.6) = 0.0555
(12) Weight of carbon burning to CO = 0.0555 × 0.7198 = 0.040
(13) Heat loss from CO = 0.040 × 10160 = 406 Btu
(14) Percent heat loss from CO = 100 × 406 ÷ 13,800 = 2.94%
(15) Theoretical air per pound coal

	Lb of combustible	Lb O_2 required per lb comb	Lb O_2 required
Carbon	0.7198	2.67	1.922
Hydrogen	0.0647	8.00	0.518
Sulphur	0.012	1.00	0.012
Total			2.452
Less oxygen in the coal			0.087
Net oxygen needed			2.365 lb × 4.32 = 10.22 lb air

(16) Excess air = 16.32 − 10.22 = 6.10 lb
(17) Percent excess air = 6.10 ÷ 10.22 = 59.7%

Consolidated Combustion Data: Air Required and Combustion Products

Table gives required combustion air and products for common combustibles burned with theoretical air requirements. Air and products are given in mols, cu ft and lb (see right-hand column) for 1 mol, 1 cu ft and 1 lb of fuel

Fuel	For 1 mol of fuel: Air O_2	Air N_2	Other products (than N_2) CO_2	H_2O	SO_2	For 1 cu ft of fuel: Air O_2	Air N_2	Other products (than N_2) CO_2	HO_2	SO_2	For 1 pound of fuel: Air O_2	Air N_2	Other products (than N_2) CO_2	H_2O	SO_2	
C	1.0	3.76	1.0								.0833	.313	.0833			Mols
	379	1425	379								31.6	118.8	31.6			Cu ft
	32.0	105	44.0								2.67	8.78	3.67			Pounds
H_2**	0.5	1.88		1.0		.00132	.00496		.00264		.250	.940		0.5		Mols
	189.5	712		379*		0.5	1.88		1.0*		94.8	356		189.5*		Cu ft
	16.0	52.6		18		.0422	.139		.0475		8.0	26.3		9.0		Pounds
S	1.0	3.76			1.0						.0312	.1176			.0312	Mols
	379	1425			379						11.84	44.6			11.84	Cu ft
	32.0	105			64						1.0	3.29			2.0	Pounds
CO	0.5	1.88	1.0			.00132	.00496	.00264			.179	.0672	.0357			Mols
	189.5	712	379			0.5	1.88	1.0			6.77	25.4	13.53			Cu ft
	16.0	52.6	44.0			.0422	.139	.116			.571	1.88	1.57			Pounds
CH_4	2.0	7.52	1.0	2.0		.00528	.0198	.00264	.00528		.125	.470	.0625	.125		Mols
	758	2850	379	758*		2.0	7.52	1.0	2.0*		47.4	178	23.7	47.4*		Cu ft
	64.0	210	44.0	36.0		.169	.556	.116	.0950		4.0	13.17	2.75	2.25		Pounds
C_2H_2	2.5	9.40	2.0	1.0		.0066	.0248	.00528	.00264		.0962	.362	.0769	.0385		Mols
	947	3560	758*	379*		2.5	9.40	2.0	1.0*		36.4	137	29.15	14.58*		Cu ft
	80.0	263	88.0	18.0		.211	.694	.232	.0475		3.08	10.13	3.38	.692		Pounds
C_2H_4	3.0	11.29	2.0	2.0		.00792	.0298	.00528	.00528		.1071	.403	.0714	.0714		Mols
	1137	4280	758	758*		3.0	11.29	2.0	2.0*		40.6	153	27.1	27.1*		Cu ft
	96.0	316	88.0	36.0		.253	.834	.232	.0950		3.43	11.29	3.14	1.286		Pounds
C_2H_6	3.5	13.17	2.0	3.0		.00923	.0347	.00528	.0079		.1167	.439	.0667	.10		Mols
	1326	4990	758	1137*		3.5	13.17	2.0	3.0*		44.2	166.3	25.3	37.9*		Cu ft
	112.0	369	88.0	54.0		.296	.972	.232	.1425		3.73	12.29	2.93	1.8		Pounds

* The volumes shown for H_2O apply only where the combustion products are at such high temperature that all the H_2O is a gas.
** Varying assumptions for molecular weight introduce a slight inconsistency in the values of air and combustion products from the burning of hydrogen. True molecular weight of hydrogen is 2.02 but the approximate value of 2 is used in figuring the air and combustion products.

THE OPERATING ENGINEER

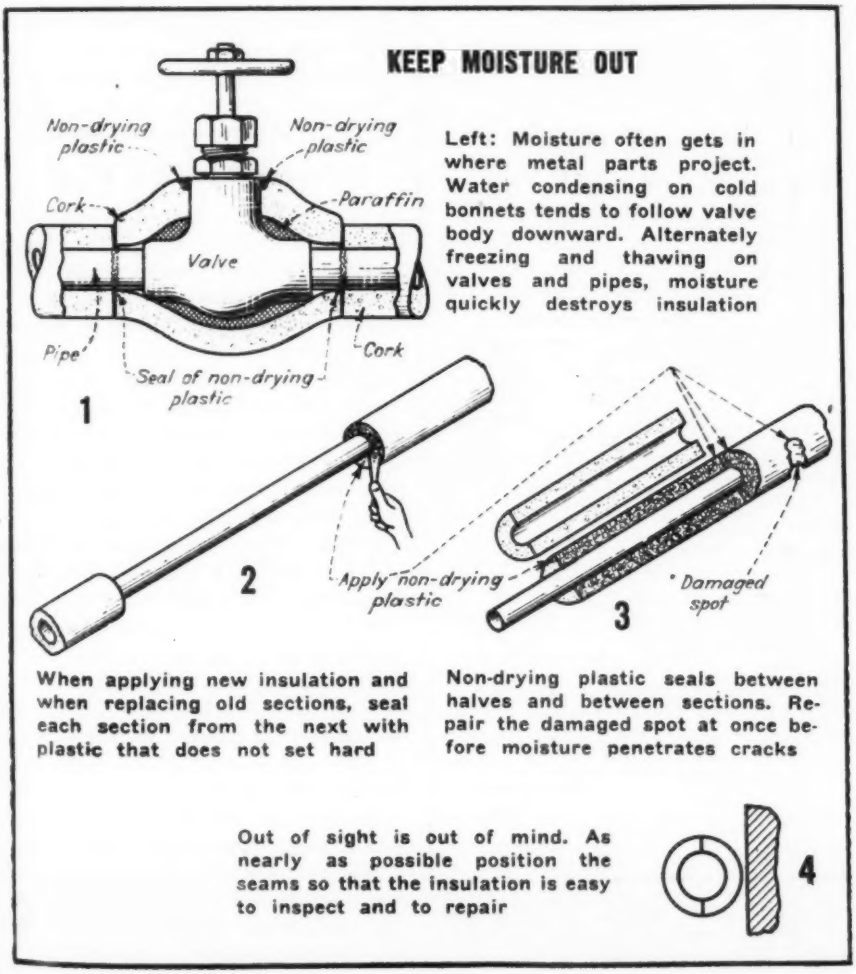
George Edwards *Advisory Editor*

PRACTICAL AIDS • MAINTENANCE HINTS • QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Preformed Cork Pipe Insulation— Here's How to Keep It Dry Inside

George Holman gives useful information on application, maintenance and repair. Moisture is the chief enemy when insulation is applied to cold lines. Here are ways of keeping water out to prolong the insulation life and efficiency*



Left: Moisture often gets in where metal parts project. Water condensing on cold bonnets tends to follow valve body downward. Alternately freezing and thawing on valves and pipes, moisture quickly destroys insulation

When applying new insulation and when replacing old sections, seal each section from the next with plastic that does not set hard

Non-drying plastic seals between halves and between sections. Repair the damaged spot at once before moisture penetrates cracks

Out of sight is out of mind. As nearly as possible position the seams so that the insulation is easy to inspect and to repair

▶ THE KIND OF INSULATION used on hot lines to keep heat *in* would serve equally well to keep heat *out* of cold lines if it were not for the water that condenses on and within insulation applied to cold lines. Most types of hot-line insulation are not well suited to exclude and resist moisture. Another objection to hot-line insulation on cold lines is the fact that the costly temperature-resisting qualities of asbestos, magnesia and similar insulators have no commercial value on cold lines.

In general, therefore, cold pipes are covered with materials of good heat-insulating qualities, but not necessarily having special resistance to temperature. These include cork, mineral wool, hair felt, etc. Where surroundings are dry and fluid temperature not too low, even paper insulation may be used.

Condensed atmospheric moisture, whether or not accompanied by freezing and thawing, is far more destructive of low-temperature insulation than all other factors combined. Prefabricated cork insulation is especially subject to moisture and deteriorates rapidly under wet or humid conditions. To protect its good insulating qualities, it should be properly installed.

There are two ways in which water may penetrate insulation. If the outer surface of the insulation is often below the dewpoint, moisture collects on the surface and then penetrates the insulation at points where waterproofing is inadequate and the insulation porous.

Even though the surface is above the dewpoint, porous and inadequately waterproofed insulation can still get soaked from internal condensation. There is always some "breathing" of

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damp air working through the cracks and into the pores. If the surface is not completely sealed, the cork in time becomes saturated with condensation. The water not only neutralizes the insulating values of the material but also may cause or conceal pipe corrosion and serve to harbor foul and harmful odors. The worst possible situation is encountered when conditions cause alternate freezing and thawing.

In refrigerating systems the life of cork insulation under humid conditions depends on how well it has been applied and on little else. The seams are the critical areas. Small seams should be filled with plastic non-drying material. Large seams should be filled with a coarser putty, or with a mixture of plastic and pulverized cork, then finished with plastic. Dip the putty knife repeatedly into turpentine or kerosene for an effective waterproof cement.

In wet surroundings a coat of waterproof cement applied generously with a brush immediately after the seams have been sealed prolongs the life of cork insulation for years.

Since water penetrates cracks at the juncture of the cork surface and exposed metal parts, take special care to seal the seams between the cork and valve bonnets and pipe flanges, also points where bare evaporator pipes join the insulated return lines. Such seals should always be of non-drying plastic and not of hardening cement.

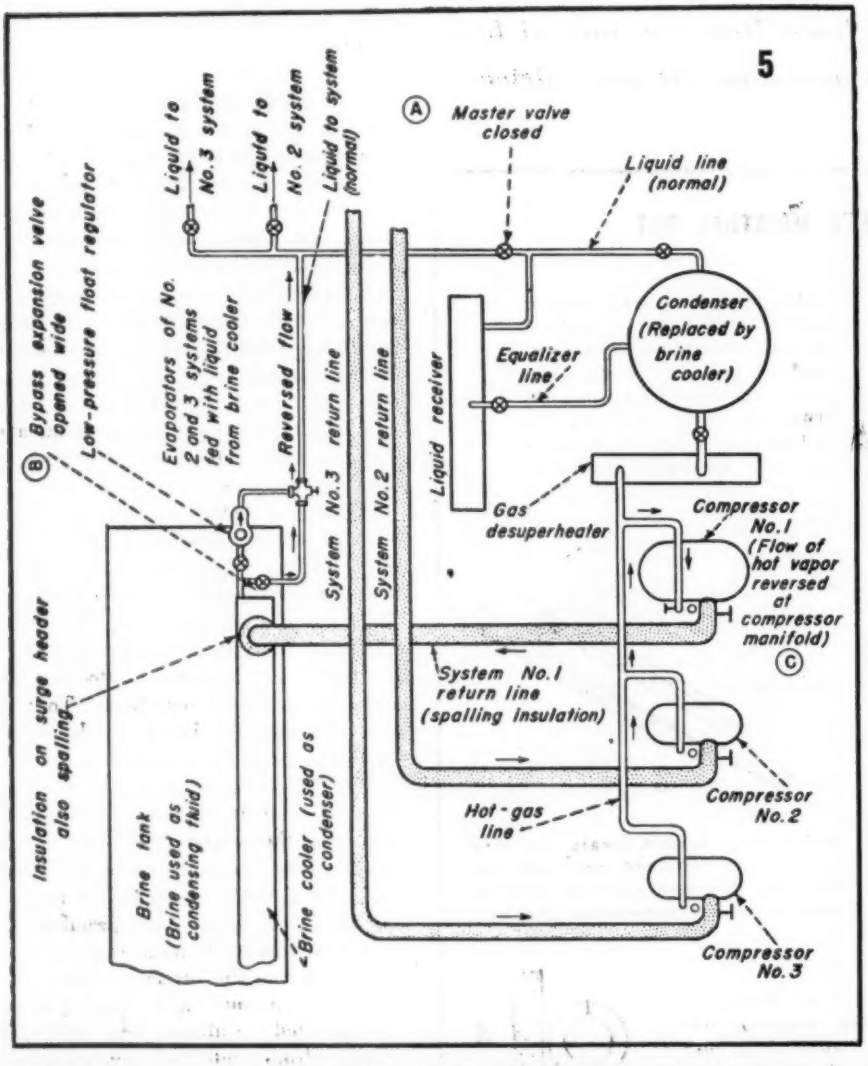
Water may penetrate the surface of cork insulation without the knowledge of the operator or even of a critical inspector. So far there is no suitable way to determine the quantity of moisture in cork-pipe insulation without destroying it. Even destructive tests are unreliable since the quantity of moisture in one section of the insulation may differ from that in another.

Moisture often remains undetected in the cork, freezing and thawing until surface cracks reveal the damage. Unless he can take insulated lines out of service there is little the operator can do to preserve damaged insulation other than "putty it up." If the insulation is already wet inside, puttying can be only a makeshift. It cannot remove the cause of new cracks, some of which may form immediately.

On the other hand, where plants operate seasonally, insulation may be dried out during the off season by keeping its surroundings warm and dry. Cold winter air expanding into a warm room in which the insulated piping system is located may dry out wet cork insulation within two or three weeks.

If the system can be drained, insulation may be dried by passing either hot air or the hot refrigerant vapor through the pipe it covers. Steam is a very effective drying agent, but it may leave water in low parts of the system, and it is also likely to overheat paraffin, plastic seam filler and similar materials. Best of all is the heating by hot refrigerant vapor.

Once dried, the cracked insulation should be repaired or replaced without delay. For repair, start by filling the cracks with a good plastic and draw the insulation together with wire or tape. Then apply a smooth coat of asphalt or waterproof cement. A coat of aluminum paint over plastic keeps the waterproofing from "coming through" the finish coat of paint.


5
Liquid to No. 3 system
Liquid to No. 2 system
Liquid to system (normal)
A
Master valve closed
Liquid line (normal)
Bypass expansion valve opened wide
Low-pressure float regulator
Evaporators of No. 2 and 3 systems fed with liquid from brine cooler
Reversed flow
System No. 3 return line
System No. 2 return line
Liquid receiver
Equalizer line
Condenser (Replaced by brine cooler)
Gas desuperheater
Compressor No. 1 (Flow of hot vapor reversed at compressor manifold)
C
System No. 1 return line (spalling insulation)
Insulation on surge header also spalling
Brine tank (Brine used as condensing fluid)
Brine cooler (used as condenser)
Hot-gas line
Compressor No. 2
Compressor No. 3

By shutting down No. 1 compressor and adjusting certain valves, hot refrigerant vapor from the remaining compressors was used to dry out spalled insulation on the return line and brine cooler. See end of article for details

Drying With Hot Vapor

Fig. 5 shows how hot refrigerant vapor was used to dry out spalled insulation on return line and brine cooler. Cause of the spalling was moisture penetration followed by alternate freezing and cooling.

Compressor No. 1 was shut down after reducing brine temperature to zero. Then the master liquid stop valve was closed, *A*, and the auxiliary expansion valve bypassing the low-pressure float regulator opened wide, *B*. Opening both bypass and pump-out valve at the No. 1 compressor pressure manifold, *C*, allowed hot vapor from No. 1 and 2 compressors (which were much smaller) to pass through to No. 1 return line. This refrigerant was condensed in the brine cooler and then forced upward through the auxiliary expansion valve and into the liquid line feeding No. 2 and 3 systems. The cork dried out within 24 hours, during which brine temperature rose 25 deg.

When thus freed of moisture the cork was puttied up, rewired and painted. This repair has lasted as long as the original insulation.

MATH TIPS

PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

4—Good Ways to Multiply

▶ MULTIPLICATION MAY BE EXACT or approximate. Allowing for the value of a man's time, approximate multiplication is often smarter engineering than the exact variety. This is particularly true where the exactness in figuring is wasted either because it greatly exceeds the accuracy of the data or because the figuring is far too finespun for the given problem.

To reverse an old adage, "never use a man to do a boy's work." Also don't measure firewood with a micrometer or figure the volume of a roof tank to the thousandth part of a gallon.

However certain rules of arithmetic won't work except for exact multiplications. For example, here's the usual one for placing the decimal point in the product of two decimals.

Rule: First multiply the two numbers as whole numbers. Then given product has as many decimal places as are in two numbers combined.

Example: Multiply 24.3 by 0.0613. First, 243×613 = 148,959. Decimal places in two numbers multiplied total five, so correct product is 1.48959.

Now it's clear that this rule won't work unless the multiplication is complete to the last digit. That's why it won't work with slide rule or other approximate multiplication methods.

To avoid this limitation we recommend discarding this rule and placing the decimal point by "inspection," that is by common sense. For example, here we are multiplying 20 plus by 1/20 plus, so the answer must be a little more than one. The only possibility is 1.48959. Likewise if the product were read on the slide rule as 1490 the same procedure would give 1.490.

Checking Multiplications

When checking an operation in arithmetic try to do the job some new way to avoid repeating the same mistakes. For example, if you add a column of figures reading *down* from the top, why not check reading *up* from the bottom?

Also, when checking a multiplication, don't merely repeat the original operation. It is much safer to reverse the numbers and remultiply, like this:

Problem: What is 462x893?

462	893
893	462
1386	1786
4158	5358
3696	3572
412566	412566

With the operations thus completely changed, duplication of a wrong product is much less likely than if the first multiplication were merely repeated.

Significant Figures

The first two articles of this series stressed the practical importance of significant figures, noting that 3 or 4 SF are satisfactory for most engineering problems and that often 2 SF are good enough.

Strangely enough, practical engineers, educated on the job, have often been the greatest offenders in such matters. Boiler efficiencies crudely determined have been reported to six or seven significant figures, like this: 76.8432%—an indicated precision far beyond the capacity of the world's finest testing laboratories. It isn't sensible.

When two or three numbers are multiplied to give an area or volume, each number introduces its own percentage error into the product. That is, if two of three numbers to be multiplied are correct and one in error by 3% the product will be 3% wrong.

If all three numbers are in error, the errors may add up or partly cancel. Most often the net percentage error of the product is somewhat greater than the largest percentage error in one of the individual numbers.

Take a case where a sheet of metal is miked .016 in. to the nearest thousandth. The right thickness might be anywhere from .0155 in. to .0165 in. Now 0.0165 differs from .016 by about 3%. Suppose the other dimensions of the sheet are measured, correctly to 1/100 in., as 43.02 in. and 25.43 in.

In working out the volume of this sheet it is a waste of time either to record or use the final 2 and 3. If you drop the 2 and use 43.0 the resulting error is only 1/20%. The error from dropping the 3 and using 25.4 is only about 1/10%. These errors are unimportant when the thickness figure may throw the volume off by 3%.

In this case, then, write: volume = 43.0×25.4×0.016. At each stage drop all figures beyond 3 SF as useless.

Then:

254	
43	
762	
1016	
109	**to 3 SF**

Point off to 1090.

Next, multiply 1090 by 0.016

109	
16	
654	
109	
174	**to 3 SF**

Point off to 1.74 cu in. Considering the 3% possible error in thickness, the true volume here may range anywhere from about 1.70 to 1.80.

If carefully used, the lower (CD) scales of a 10-in. slide rule give an error of about 1/10% in multiplying two numbers and a somewhat higher error when several numbers are multiplied. The slide rule is recommended where this error is not objectionable, which is true for most practical engineering calculations.

Suppose the following numbers are to be multiplied longhand *dependably* to three SF: 0.0024632×25.41×465.132.

To play safe, write each number and operation to 4 SF. Neglecting decimal points we then have 2463×2541×4651.

First:		**Then:**	
	2463		6258
	2541		4651
	2463		6258
	9852		31290
	12315		37548
	4926		25032
	6258		2910

Answer must approximate 1/500×25×500, so it will be about 25. Accordingly write 29.10 as the final product. This is dependable to 29.1.

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men

HOIST ON TRUCK DOES HEAVY JOBS

MOVING HEAVY EQUIPMENT and parts around large plants is frequently quite a problem. A solution for this is an old truck equipped with a lifting beam, as in the photo above. At each corner of the truck's platform we bolted down an H-column and connected the top of the front and the rear columns by an H-section.

The columns are braced lengthwise of the truck by angle irons and the two front columns are also braced crosswise by angle irons. To give free access to the rear end of the truck's platform the rear columns are not braced by angles, but have substantial plate-steel gussets in the corners at the columns' top.

An I-beam of sufficient length to extend about 3 ft beyond the truck's rear end and bolted to the H-sections topping the columns serves as a lifting beam for a chain fall on a trolley. When a heavy part is to be moved from one part of the plant to another we back the truck up to it. Then we run the chain fall out over the load, lift it above the truck's platform, run the load on the truck and lower it on the platform for transportation.

This old truck, used in many ways for handling material around the plant and yard, has paid for itself a dozen times.

Troy, N. Y. GILBERT LINDGREN

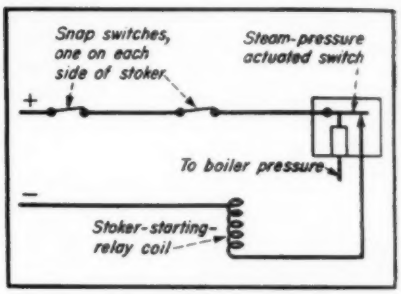
Stoker Switches Prevent Backfire

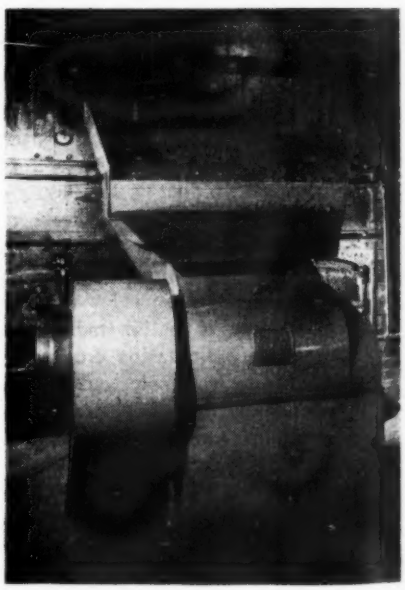
IF WE WANT WORKMEN not to take chances we must provide convenient facilities for them. Neglecting a simple detail may lead to an accident, as in our plant. We equipped one of our hand-fired boilers with a forced-draft stoker, which was so installed through the front of the furnace that a firedoor remained in place on each side of it, as in the photo. The fireman uses these doors to inspect the fires.

The stoker is started and stopped automatically by a steam-pressure-actuated switch. A slightly positive pressure exists in the furnace when the stoker is in operation. To eliminate the possibility of backfire, the fireman is required to shut off power to the stoker motor before opening the fire doors to inspect the fire. To make it convenient for him to shut off the power we installed a switch on one side of the stoker.

One day when the automatic switch stopped the stoker the fireman was on its opposite side from the safety switch when he decided to inspect the fire. Taking a chance that the stoker would not start he opened the fire door without opening the safety switch. When his face was near the open door the automatic switch started the stoker and the fireman got the full effects of the backfire. Fortunately he was not seriously injured.

To leave no excuse for not opening

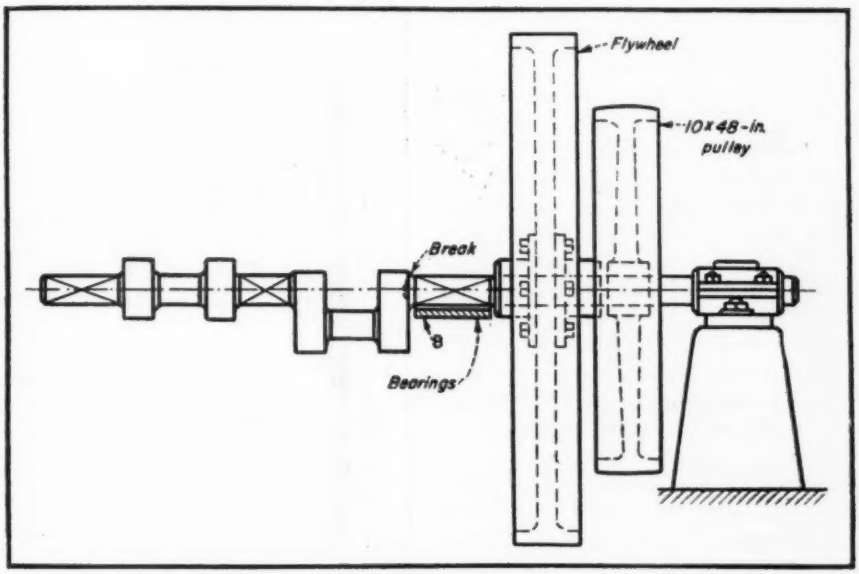




the stoker starting circuit before inspecting the fire I installed another switch in this circuit. There is now a switch on each side of the stoker conveniently located near the fire doors for the fireman. These switches are connected in series with the steam-pressure-actuated switch as in the diagram.

Englewood, N. J. R BOETTINGER

Poor Bearing Alignment Breaks Crankshaft



THE DIAGRAM shows the crankshaft, flywheel, pulley and outboard bearing of our vertical compound steam engine. A 10-in. belt connects the 48-in. pulley on the engine shaft to a similar one on a lineshaft. We had considerable trouble with this belt crowding one side of the pulley. This trouble kept getting worse until the master mechanic decided to correct it by realigning the two pulleys.

Instead of lining up the engine bearings he jacked up the outboard end of the shaft and installed a new concrete pier to carry this bearing and bring the pulleys in line. The job looked swell with the belt running correctly on the pulleys. After about one month's operation the crankshaft broke in the crank's web, as indicated on the drawing, at the right.

After removing the broken crankshaft, a checkup on bearing alignment showed that the maintenance crew had raised the outboard bearing to line the pulleys without aligning the engine bearings with it. As a result the crankshaft was running clear of the main engine bearing *B* to the left of the flywheel.

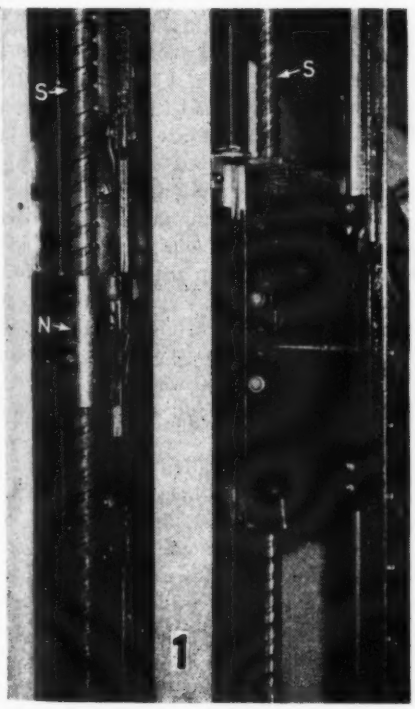
Unsupported load on the crankshaft at this point was about 4000 lb. As the shaft rotated this load put severe bending stresses in the crankshaft web where the bearing journal connects. As a result the metal fatigued rapidly and failed, something that proper shaft alignment could have prevented. The break was repaired by welding after carefully aligning the crankshaft and clamping it rigidly in place so that it could not move during welding.

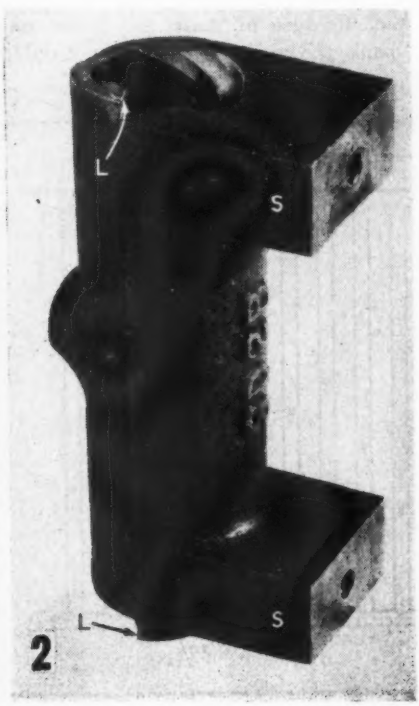
Philadelphia, Pa. R O SPENCER

BABBITTED NUTS REPLACE BRONZE ON ELEVATORS

ON PASSENGER ELEVATORS in the McGraw-Hill building the floor-selector-brush carriages are driven by two vertical 1.5-in. screws *S*, turning in long nuts *N* attached to the carriage, Fig. 1. These nuts became so badly worn that they had to be renewed.

Fig. 2 shows one of the old nuts, which consists of a threaded bronze shell 1⅞ in. outside diameter, 6 in. long with a cast-on support *S* at each end. Each support is tapped and threaded for a ⅜-in. tap bolt for connection to the carriage. A lip *L* at each end of the shell meshes with a fixed nut at top and bottom ends of the driving screw to correct the selector-carriage position at car travel limits.





Our first consideration was to bore out the old nuts and pour a babbitt thread in them, but these shells were not thick enough to do this and have sufficient thickness of babbitt outside the screw thread. We therefore decided to make new nuts in which we could renew the threads when necessary.

We made the shells for the new nuts from two pieces of 2-in. steel pipe 6.5 in. long. This pipe has ⅛-in. larger inside diameter than the outside diameter of the old shells and provides ample space for a babbitted thread. At the ends of each piece of pipe we filed a ¼-in. lip, Fig. 3, which made the shells' length 6 in. To help anchor the babbitt in the shells we drilled four vertical rows of ⅝-in. clearance holes through their sides. Flathead machine screws were put in the holes with their heads on the inside and held in place by nuts on the pipe's outside, Fig. 3, page 112.

Supports of the nuts, Fig. 2, are 1 in.

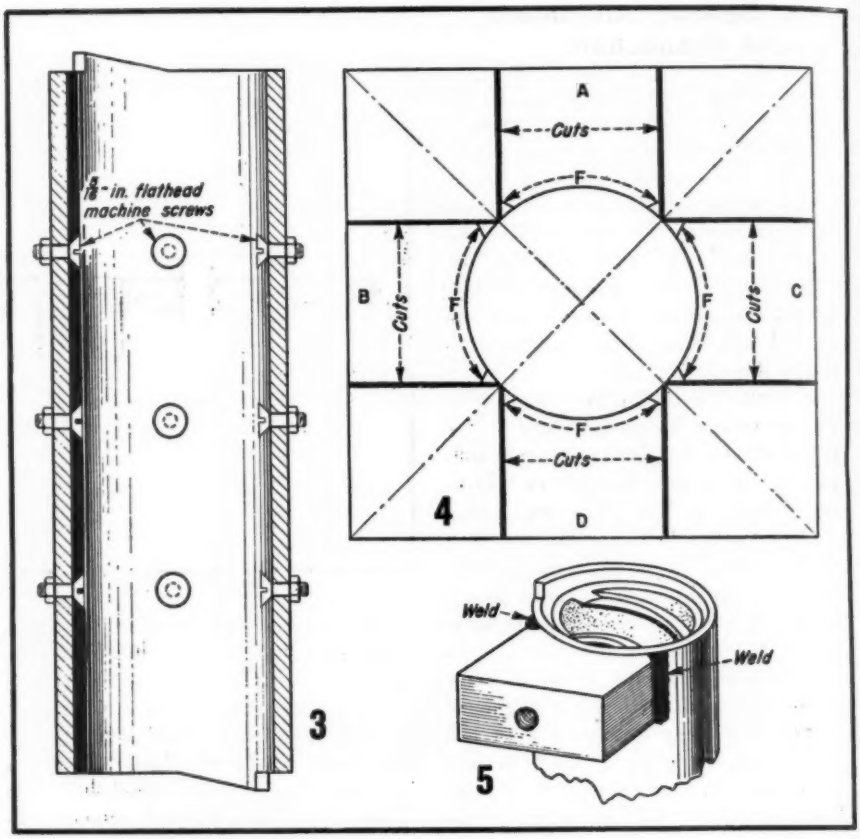
deep and measure 2 in. from center of shell to their free end. We made these supports from a piece of 1-in. steel, 4 in. square, in whose center we bored a hole the same size as the outside of the shell. Cutting the block as in Fig. 4 gave us four pieces, *A*, *B*, *C* and *D*, that fit the shells. We cut the corners *F* off the curved ends of each piece, Fig. 4, and welded them to the shells, Fig. 5. We then drilled and tapped the supports and shells for the ⅜-in. tap screws that hold them to the selector carriage. These screws are long enough to go through both support and shell to assist the weld in holding them together.

When the new shells were completed the old ones were removed, the new ones installed on the selector carriage and the space between shells and driving screws poured nearly full of babbitt. We poured the babbitt about ¼ in. low to form an oil pocket in the shell's top that assists in lubricating the nut on its driving screw.

To complete the job we removed the driving screws with their babbitted nuts and put one at a time in a lathe. After cutting off the ⅛ machine screws flush with the shell outside surface, we lubricated the screw with a mixture of oil and sulphur and ran the nut up and down it with the lathe. At first the nut had to be held with a wrench, but in about ½ hr it could be held by hand when we quit the grinding operation and installed the screws and nuts in the selector.

The babbitted nuts are wearing as well or better than the bronze ones and were produced at a small fraction of their cost. When the babbitt threads wear it will be a simple job to melt out the old and pour new ones.

New York, N. Y. FRANK SCHLIEFF



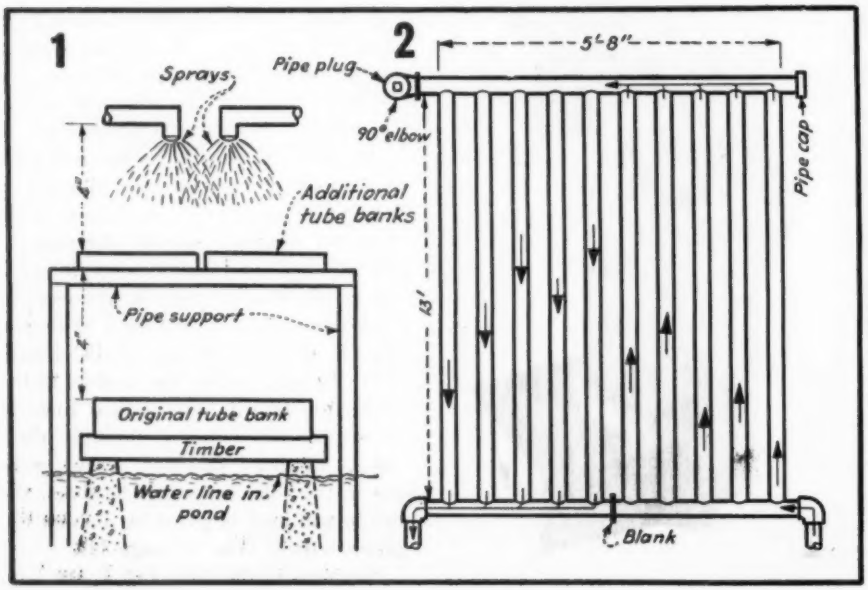
INCREASED COOLING SURFACE STEPS UP LOAD

WE OPERATE two 300-hp convertible diesel engines on butane-propane gas. These engines have a closed cooling system through which their jacket water circulates. The cooling element is a bank of pipe over which water is sprayed. Because of scale within the pipe bank, the cooling system did not reduce the jacket-water temperature as low as desired.

To eliminate this difficulty we increased the cooling surface by adding another pipe bank, Fig. 1 and 2. This pipe bank we made by welding 2-in. pipe into two headers. We did the job this way because we had the 2-in. pipe and an electric welding machine.

We made a template of light sheet iron to fit over the pipe ends to guide us in cutting them to the correct form to fit the header. A similar template was used for a guide in cutting the holes in the headers. To make two passes in the tube bank we made a square cut in one header and welded in a blank as in Fig. 2.

When we installed the tube bank above the original one, Fig. 1, we raised its return end 2 in. higher than the intake and discharge end to drain the system if that becomes necessary. On one end of the return header we installed a pipe cap and at the other a 90-deg elbow with a pipe plug, the latter for draining off air that might collect. The



new addition to the cooling system consisted of two tube banks like that in Fig. 2, placed side by side as in Fig. 1, 4-ft. above the old installation. When the additional cooling surface was put in use it permitted us to carry 30% more load on the engines.

Shiprock, N. M. JAMES F MAHER

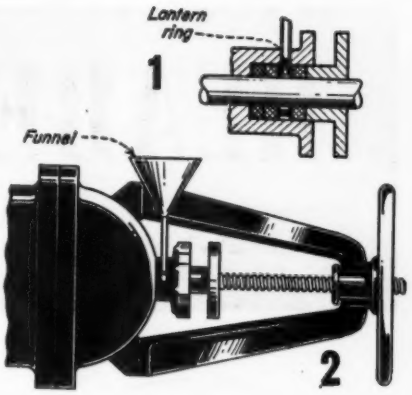
Puts Water Seals in Valve-Stem Packing

IN ONE PLANT where I worked the connections between two turbines and their condensers were cross-connected so that each turbine could use either condenser. To do this required three valves in the exhaust connections. We were having difficulty maintaining the vacuum as high as it should be for load and circulating-water temperature conditions. After checking other sources of air leaks without getting results, we turned attention to the 24-in. valves in the cross-connections.

We suspected that even though their valve-stem packings were good and tight, air was leaking by them into the condenser. We reasoned that if a water seal on a pumpshaft keeps out air, why not on a valve stem? Accordingly, we made a lantern ring in two halves for each valve stem and installed it in the stuffing box, Fig. 1.

Before putting in the rings we drilled and tapped a hole in the stuffing box opposite the second ring of packing, counting from the gland. In each of these holes we connected a funnel as in Fig. 2 and repacked the stuffing boxes, using a lantern ring in place of next to the last ring of packing. We filled the funnels with water after tightening the packing in place.

The water formed a good seal to prevent air leaking in around the valve



stem because we could maintain about 0.5-in. more vacuum than before the water seals were installed. Atmospheric pressure above the vacuum in the condenser gave about 14 psi on the water seal, which proved ample to seal the valve stem with very little leakage.

Flushing, N. Y. S M ELONKA

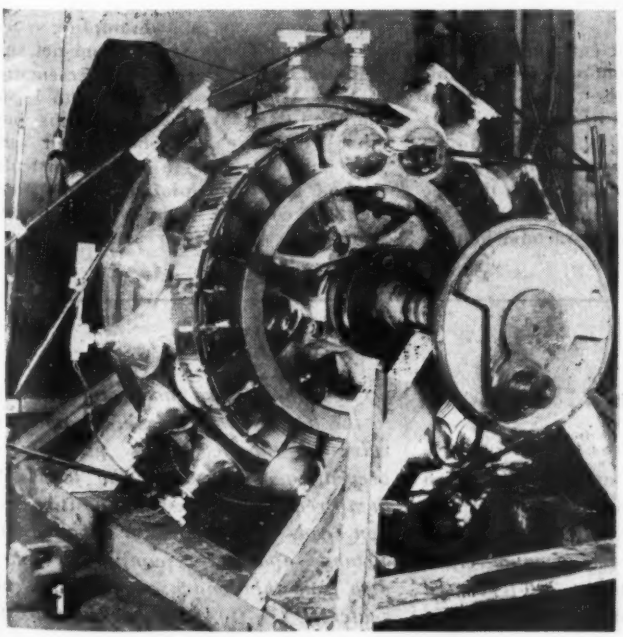
INFRA-RED HEATING CONDITIONS MOTOR INSULATION

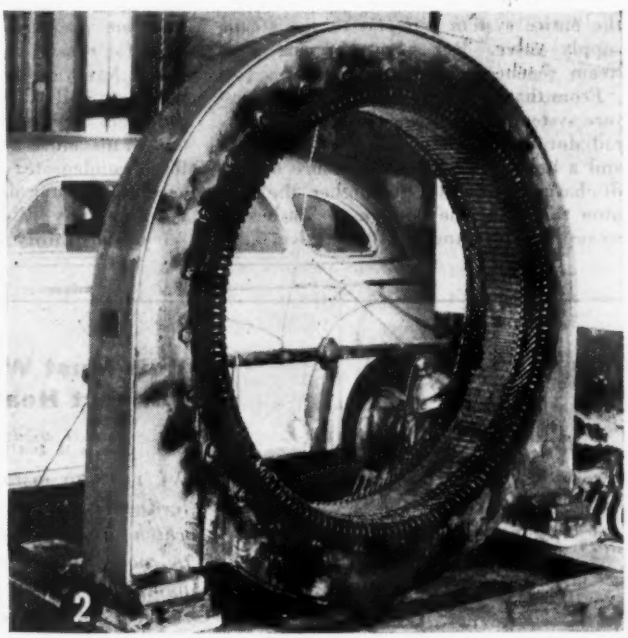
THE INFRA-RED LAMP is comparatively a newcomer in the industrial field but is used extensively for a wide variety of drying operations. We recently had the job of drying out a 200-hp 257-rpm 2200-v synchronous motor, Fig. 1 and 2. This motor connected to a compressor and had been idle for a long time during which moisture penetrated its windings and reduced their insulation resistance to less than 0.5 megohms. The owners of the motor wanted to put it in service again but before doing so its insulation had to be dried out.

This equipment was too large to dry in our oven so we decided to do the job with infra-red lamps, in the use of which we have had extensive experience. Fig. 1 shows part of the lamps set up around the motor's rotor for doing the drying. These lamps are mounted on pipe pedestals with flexible joints that permit the lamps to be adjusted to any position where their rays will be most effective in heating the windings.

Thirty-six 200-watt infra-red lamps were used on the rotor and the stator. After 36-hr drying, the insulation resistance was increased to about ten times what it was at the beginning of the drying operation or to five megohms. This is more than double the value normally considered a safe insulation resistance for 2200-v stator windings. After spraying a good coat of air-drying varnish on the windings the machine was ready for operation in less than one quarter the time that other heating methods would have required.

The Maintenance Co M A MYERS
New York, N. Y. Electrical engineer





READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

Questions From Our Readers

1—Why a Vacuum on Heating-System Return?

STEAM TO HEAT the office building comes from our nearby power plant through a reducing valve connected to the high-pressure main. Valve maintains 8-psi pressure on the heating system.

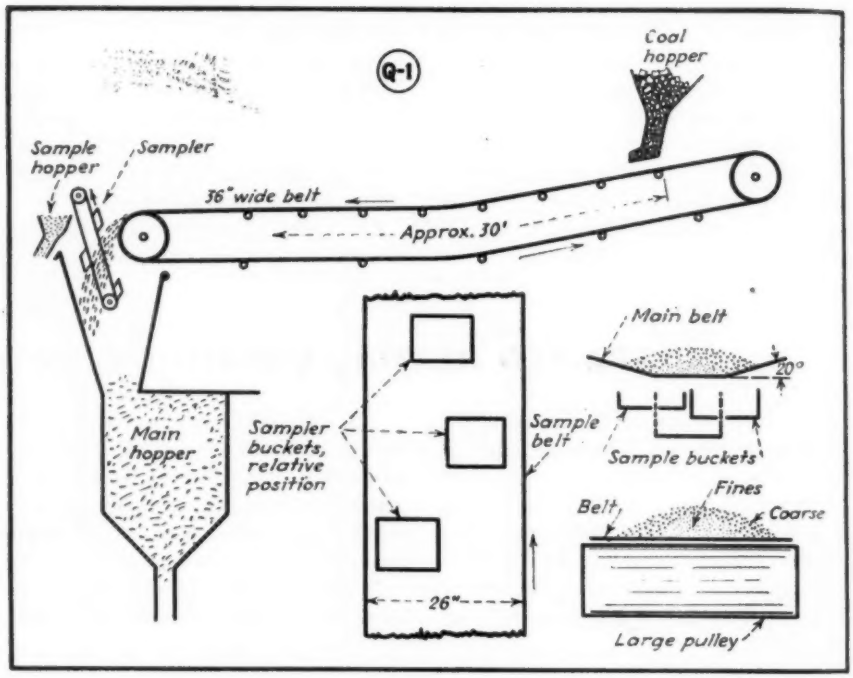
Radiators are equipped with traps and discharge condensate into a common return line having sufficient slope to drain by gravity into the vacuum-return pump. The pump operates on either float or vacuum control and is set to maintain a 7-in. vacuum on the return.

I know that running the vacuum pump before startup voids the system of air and accelerates heating because the cold radiator trap valves are off their seats and the entire system is open to the steam-supply valve. But what happens after steam reaches the radiator traps?

From that moment on we have a 2-pressure system, main steam pressure (minus radiator drop) on one side of the trap, and a below-atmospheric pressure on the discharge side. And the higher the vacuum the more the condensate flashes to steam after passtng the trap valve.

I see no advantage in maintaining a vacuum that flashes condensate to steam when the flash steam condenses after entering the vacuum-pump chamber. Maintaining a vacuum causes more flashing than ordinarily occurs at higher return-line pressures.

As for removing air entrained with the steam, how can the pump accomplish this when air collects at the top of a radiator (air vents are located in the top section) and traps must be at the bottom to release condensate? How can the vacuum accelerate water drainage unless the line is completely filled with condensate? I see no possibility of the vacuum helping to move water through a partly filled line while it remains a liquid.—*JAF*



2—Needs a Coal Sampler

I PLAN TO INSTALL a coal-sampling system as shown in sketch Q-1 but am not sure that this will give me representative samples. Coal runs from slack to 1⅝-in. lumps. I will appreciate learning how other POWER readers obtain their samples and why they use that particular method, also their opinions on how other methods compare to taking pulverized samples at stated intervals.—*AAT*

Answers to July Questions

How Must We Connect Heater?

(This is Question 1 from the July issue, with best answers from readers.)

WE PLAN *to install a new 3x7-ft open feedwater heater in the boiler room, which has only 21-ft clearance from floor to roof. At present our vacuum-return pump discharges into a 2x6-ft vented receiver located adjacent to the pump.*

I plan to mount the condensate tank up near the roof so that water will flow to the heater through a float-controlled valve (in the heater) by gravity. To prevent steam binding, the feedwater pump requires at least 8-ft positive suction head. With the heater mounted this distance above the pump, will water flow from the condensate tank into the heater if 1½- to 4-psi backpressure is

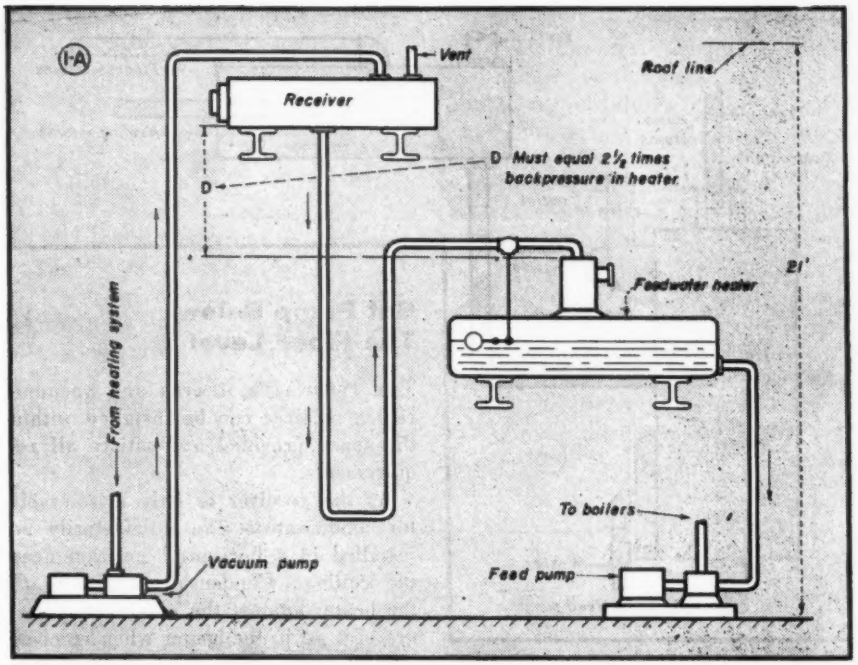
maintained in the latter? What is the best way to arrange these units and maintain a reasonable backpressure in the heater?—BSA

Connect Other Returns To Heater

IT WILL BE POSSIBLE to maintain 1½- to 4-psi backpressure on the heater if the condensate tank is mounted 10 ft above the former. *BSA* should be able to arrange the equipment within the allowable headroom and provide sufficient head on the boiler-feed pump to prevent steam binding.

Leaving the vacuum returns connected as at present, high-pressure returns can be fed directly to the heater. Thus with proper attention the feedwater can be maintained at about 200 F unless an excessive amount of cold makeup is added.

Philadelphia, Pa. T F CUNNINGHAM



Install Equalizing Line

THERE IS NOT ENOUGH HEIGHT available to install a condensate tank near the roof unless the tank can stand a working pressure of 4 psi and the vacuum pump can discharge against this pressure.

If these conditions can be met install a pressure equalizing line between the top of feedwater heater and condensate tank. Thus the latter needs to be only slightly higher than the former for water to enter the heater. With this hookup all equipment can be located in the space available if boiler-feed pump is not over 4 ft above the floor.

Tacoma, Wash. E E WATERS

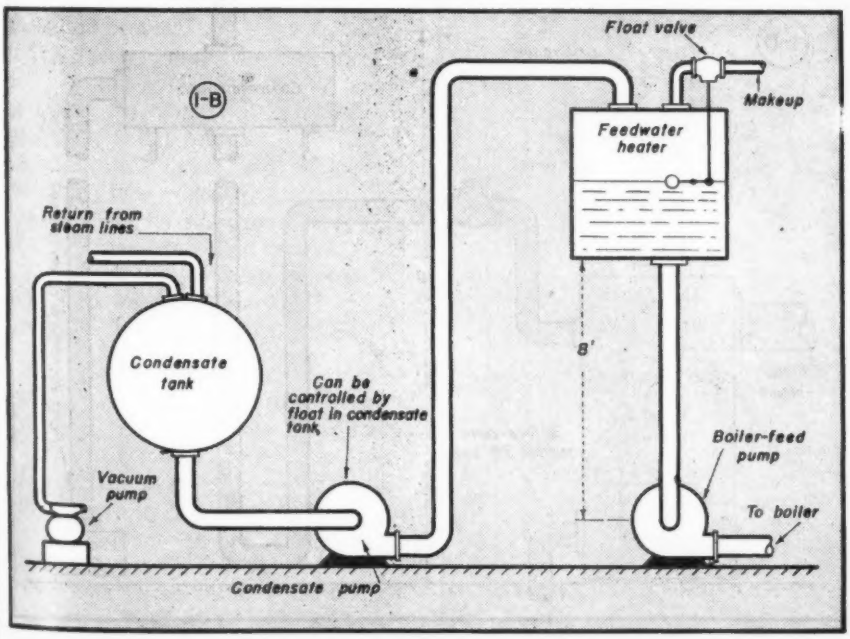
Connect Vacuum Pump to Receiver

WATER FLOWS by gravity from condensate tank to feedwater heater if the water level in the tank (this actually means the bottom of the tank) is high enough above the feedwater heater to provide a static pressure in excess of the steam pressure in the feedwater heater. Theoretically this is 2.3 ft per psi or 9.2 ft for 4-psi backpressure. If this system of supply is used additional height should be provided to insure good operation, sketch 1-A.

Although the dimensions of the pump, feedwater heater and condensate tank are not given, to secure positive suction head on the pump (this is important) and the necessary distance between feedwater heater and condensate tank, means mounting the tank on the roof. This undoubtedly would be undesirable.

I suggest the arrangement in sketch 1-B which does not depend upon gravity feed from the condensate tank. Condensate return can be fed directly into the feedwater heater without using the float-operated control valve. The latter can be used to better advantage to control the addition of makeup water to feedwater heater.

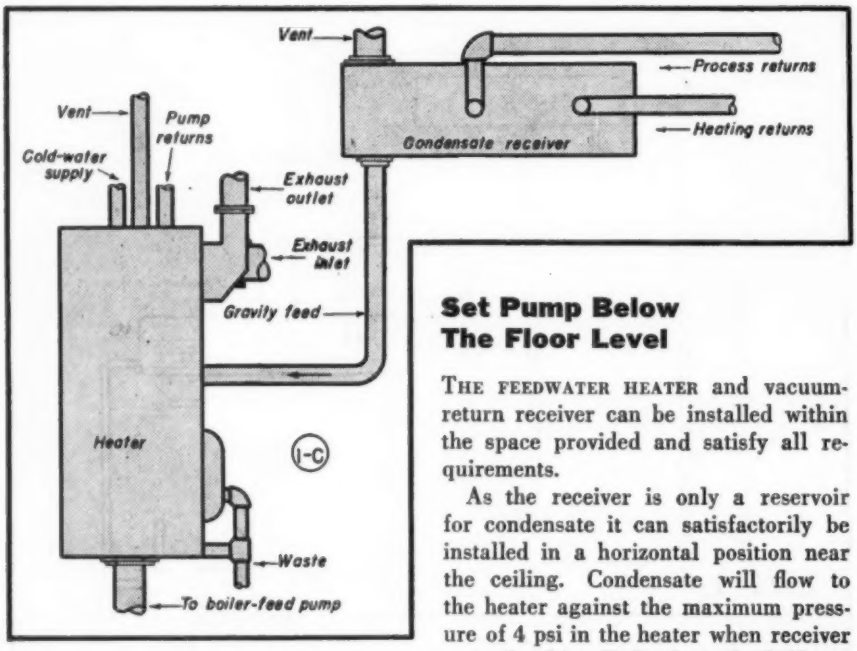
Elmira, N. Y. M H ELKIN



Put Weaker Springs On Pump Valves

WHEN LAYING OUT CONNECTIONS for his new equipment, *BSA* should remember that the condensate pump, storage tank, feedwater heater, exhaust steam line and feedwater pump are integral parts of the same system, and the operation of one part affects every other part. The open heater and feedwater pump are especially closely related, with conditions in the former vitally affecting performance of the latter. For example, a pressure of one psi in the heater is equivalent to adding 2.3 ft positive suction head to the pump, whereas raising the water temperature acts to offset it.

Under present conditions I do not believe *BSA* can set the tank high enough to induce gravity flow into the heater against a pressure of 4 psi which equals a 10-ft head. This leaves only 11 ft, most of which is taken up by the supposedly necessary 8-ft suction head



for the pump, not to mention space above the condensate level in the tank and that below heater water level.

BSA can reduce the positive suction head required, or even supplant it with a negative head by (1) lowering the feedwater temperature (2) placing weaker springs on the pump suction valves. This assumes that pump plungers and valve seats are in good condition, and that the suction line is large enough and unobstructed.

By adopting these changes he may be able to set the heater lower, perhaps into a pit. This would provide ample room for setting the storage tank high enough to feed water into the heater against 4-psi pressure.

Marissa, Ill. GEORGE HOLMAN

Check Valve Prevents Backflow

THE HOOKUP IN 1-D, almost identical with the requirements described by *BSA*, is operating in our plant.

A check valve is installed between feedwater heater and condensate tank as a precaution against overpressure in the heater forcing condensate back through the tank vent.

Only difference between our plant and the layout in the question is that our boiler-feed pump is located in a pit 3 ft below the boiler-room floor. It is 21 ft from pump suction to roof.

If a positive backpressure within the limits described is kept on the feedwater heater *BSA* should have no difficulty in maintaining a positive suction pressure on the boiler-feed pump.

Bronx, N. Y. ANTHONY GREER

Set Pump Below The Floor Level

THE FEEDWATER HEATER and vacuum-return receiver can be installed within the space provided and satisfy all requirements.

As the receiver is only a reservoir for condensate it can satisfactorily be installed in a horizontal position near the ceiling. Condensate will flow to the heater against the maximum pressure of 4 psi in the heater when receiver water level is a little above the half-way mark. Pipe between receiver and heater should be of generous size to keep friction loss to a minimum.

With the minimum heater pressure of 1½ psi the 8-ft positive suction head required by the pump will be provided when the level of water in the heater is 5 ft above pump suction. As the pressure in the heater increases a lower water level will suffice. It would be well to provide control to maintain the 5-ft level in the heater. If conditions permit, additional working space might be secured by setting the pump a foot or more below floor level. This would also increase the pump suction head.

Pittsburgh, Pa. C J WYROUGH

Use Height Advantageously

I SUGGEST that BSA connect the feedwater heater as in sketch 1-C. Placing the condensate receiver and heater in these positions utilizes the height to give maximum head on the boiler-feed pump. Locating top of heater six inches below bottom of receiver puts a positive suction head of 11 ft on feed pump.

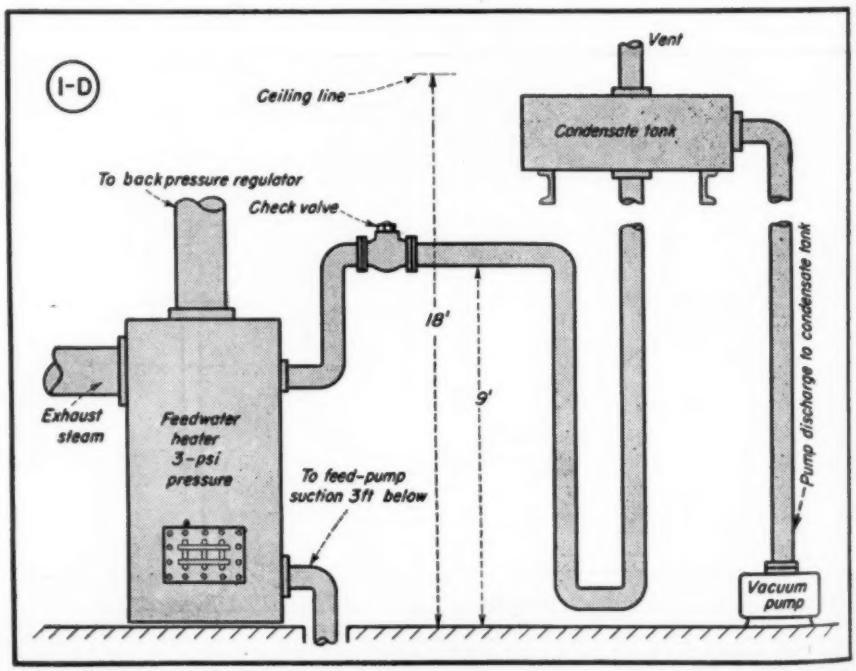
Hot condensate from the receiver would then flow into the side of the heater just above normal water level. Exhaust steam would add heat to makeup water entering at top of heater. Even with this arrangement there may be some difficulty unless the backpressure is carefully adjusted.

Philadelphia, Pa. W T MULLEN

Mount Condensate Tank on a Tower

THE HOOK-UP planned by *BSA* will not work if a pressure greater than 1½ psi is to be maintained on the heater. The reason is obvious: Clearance from floor to roof is only 21 ft. If we assume that the pump inlet is 1½ ft from the floor, and that heater is 7 ft high and must set 8 ft above the pump suction, then the distance from the top of the heater to the roof would be only 4½ ft. If condensate tank is set against the roof and stays full of water, there would be only 1.953 or 2 psi to force water into the heater.

For good operation condensate tank should be about 12 ft above the heater. There are several ways to solve the problem depending on the conditions and material available. (1) Condensate tank could be set above the roof



on a small tower to give the required head. But header and pipes would have to be heavily insulated to prevent heat loss and freezing. (2) Heater backpressure can be lowered to about 1 psi. This would lower heater efficiency but the cost or inconvenience of another installation might more than offset the lower efficiency. (3) Return pump can discharge directly to the heater. If this is done install a relief valve bypass to a storage tank for protection against flooding the heater. (4) A separate pump can be installed to take suction from the condensate tank and discharge to the heater. If this method is used, control the flow either with a motor cutout or float-controlled bypass.

Baltimore, Md. C W PARKS

Condensate Tank Provides Storage

THE OBJECT of a condensate storage tank is to provide a place to hold the large amount of water that accumulates during startup when the entire system is cold. It also provides a reserve supply of water for the boiler until condensate starts returning.

Water level in the heater should be controlled by a float-operated valve on the fresh-water line, and an overflow line that drains off excess water. Thus the heater is protected against both high and low water.

Oaklyn, N. J. C A WILKES

Mount Tanks Horizontally

IF BSA WISHES to have the condensate flow from the condensate tank to feedwater heater by gravity against a backpressure of 1½ to 4 psi, he must locate the condensate tank at least 9.24 ft above the heater.

This figure is based on the fact that one-psi pressure equals 2.31 ft height of water; therefore, for a pressure between 1½ and 4 psi, 4x2.31 = 9.24 ft.

Taking this figure and adding the following, it is evident that there is not enough room for a gravity-flow system.

8 ft: positive head needed
7 ft: height of new heater
6 ft: height of receiver
9.24 ft: height needed for 4 psi

30.24 ft total

This allows no clearance between tank and roof nor floor and pump.

If receiver tank and feedwater heater are installed on their sides and the distance between pump and heater reduced, the gravity-flow system could work provided the 9.24-ft height of receiver tank above heater is maintained.

Newark, N. J. R C CONK

Suggests Removing Condensate Receiver

IT IS NOT NECESSARY to use the vacuum-return receiver. Bearing in mind the operating conditions given, I suggest the following:

(1) Connect condensate-pump discharge line directly into top of heater.

(2) Connect the makeup line (city water or any other source of water used for supply) into top of heater. This line should have a hand valve for adjusting the makeup feed. If the valve is out of reach fit it with a chain wheel or similar device so that the operator may regulate makeup from the floor.

(3) Install a thermostatic valve on the steam line to the heater. A bypass arrangement on this valve may be used. Use a trap on return.

(4) Provide a vent on feedwater heater.

(5) The float in the heater should control the boiler-feed pump's steam valve so that when the water level in the feedwater heater drops, the float will shut off steam to the pump. Should the level rise again, the float will open the steam valve. Provide a bypass arrangement on this valve for emergency. This is the simplest and most economical plan for solving the problem.

Brooklyn, N. Y. A J WENIG

What Becomes Of the Flyash?

(This is Question 2 from the July issue, with best answers from readers.)

WE HAVE *one 1500- and four 1000-hp boilers and are adding two 1500-hp units, all to be fired by underfeed stokers. Because the plant is inside the city limits we are also installing flyash collectors. The problem now confronting us is disposal of the flyash from the collectors.*

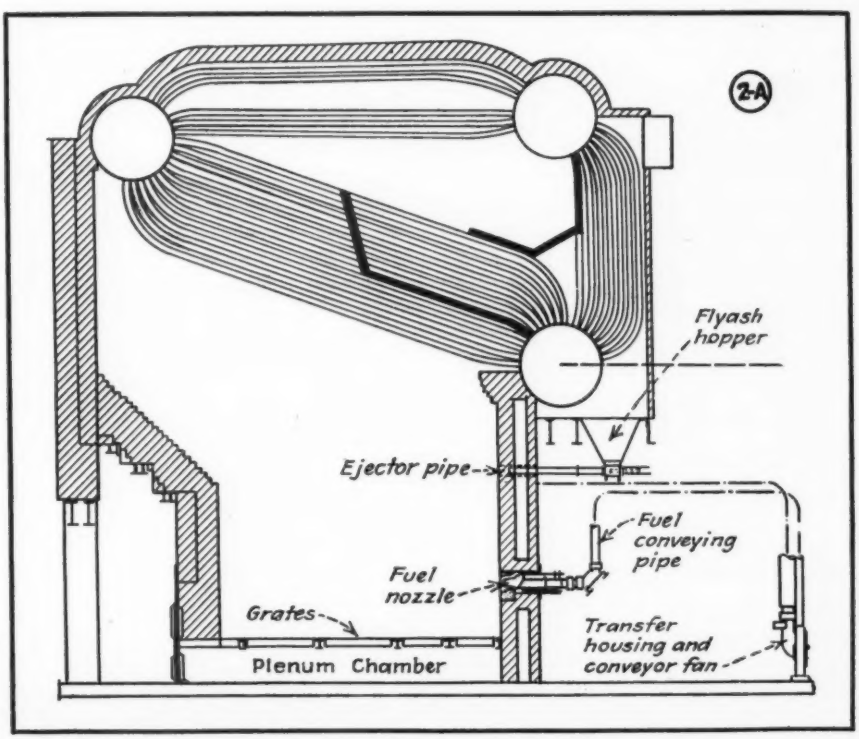
It has been suggested that we (1) flush it into a storm sewer (2) pump it to a dump (3) discharge it into the ash hopper (4) discharge it into the furnace or (5) feed it into the stoker hopper with the coal.

Disadvantages of these methods are: (1) There is no river nearby. (2) Ash is free to blow over surrounding areas when it dries. (3) Fan engineers say that the flyash, rather than falling into the ash hopper, recirculates and adds to the wear on fan blades. (4) Feeding flyash to the stoker hopper may lead to burned grates. If there are no other means of disposal which of the methods is best suited to our plant?—PRM

Describes Several Methods

HEAVY-DUTY pneumatic conveyor systems have been developed for handling ashes, flyash and soot. One system comprises a positive displacement blower, air washer and ash receiver.

(*Continued on page* 146)



CENTRIFUGAL PUMP Q AND A

By I J Karassik and Roy Carter

FOR POWER ENGINEERS

7—Materials Used in Centrifugal Pumps

Seventh in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—What determines the kind of materials in centrifugal-pump construction?

A—Centrifugal pumps are manufactured of almost all known common metals or metal alloys, as well as of carbon, porcelain, glass, stoneware, hard rubber and even synthetics. Service conditions and nature of fluid pumped determine the most satisfactory materials. Some of the factors that enter into this selection are (1) abrasiveness of suspended solids (2) corrosion resistance (3) electrochemical action (4) liquid temperature (5) head per stage (6) discharge pressure (7) suitability of material to structural features of particular pump involved and (8) load factor and expected duration of pumping installation.

Q 2—Why is there a preference for bronze pump parts, other than the pump casing?

A—Bronze does not rust and hence replacements of threaded parts are easier. Bronze parts do not seize in pumps held idle. Because bronze is easier to machine than iron and smoother surfaces can be secured at less cost, higher efficiencies are theoretically possible with bronze parts. However, bronze has limitations that frequently make it necessary to forego its advantages.

Q 3—What materials are used for pump casings?

A—Generally, centrifugal-pump casings are of cast iron, but sometimes alloy irons are used to obtain a more refined crystalline structure. Bronze is frequently used for pump casings when mildly corrosive liquids are handled as, for instance, sea water. When pressure or temperature, or both, of the liquids are so high that cast iron is no longer reliable, cast steel or even forged steel may be used for the casing. Stainless-steel casings are used when the pumped liquid is highly active chemically. Under some special conditions it may even be necessary to use a porcelain, stoneware, hard-rubber, carbon or glass casing.

Q 4—What materials are most commonly used for pump impellers?

A—Bronze impellers are generally preferred when handling average waters because bronze does not rust. Casting it in complicated cored sections, machining it, and making its surfaces smooth are easy. However, bronze impellers in cast-iron casings are undesirable if liquid is a strong electrolyte; therefore iron, cast steel or even stainless steel may be used. The latter two, while more costly than cast iron have several advantages. Because bronze has a higher coefficient of thermal expansion than its steel shafts, cast-steel or stainless-steel impellers are used extensively if water temperatures exceed about 250 F. Sometimes monel impellers are preferred to bronze when handling sea water.

Q 5—What materials are used for wearing rings?

A—Bronze is the most widely used material for wearing rings as it is for impellers. Cast-iron, cast-steel and stainless-steel rings are sometimes used, whether the impeller is of bronze or other metal. Cast steel and stainless steels are used when hardnesses or other properties unobtainable with bronze are required.

Whether single- or double-wearing rings are used, generally practice is to make the rotating part of a harder metal than the stationary.

Q 6—What materials are used for pump shafts?

A—In pumps with shaft sleeves, shafts are generally of open-hearth forged steel. With some corrosive liquids, some seepage may occur either through the pores of the impeller hub or the joint between impeller and sleeves. Such conditions require a noncorrosive

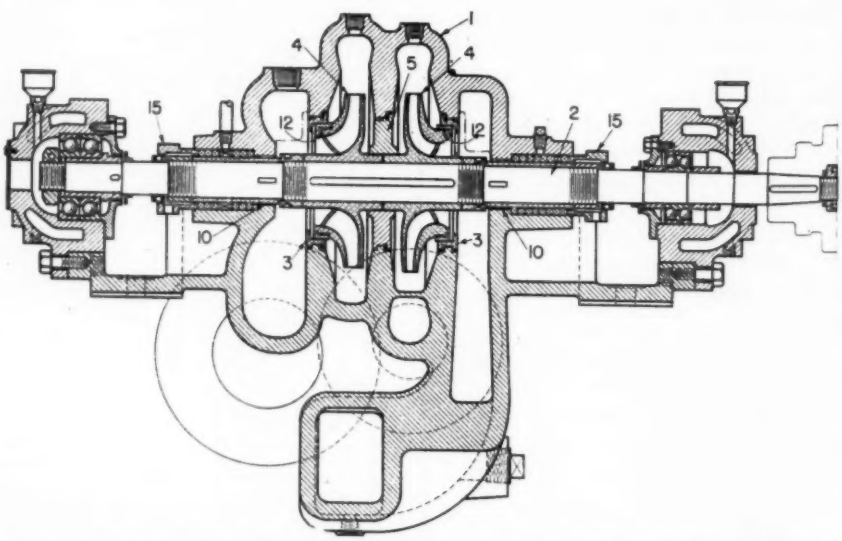
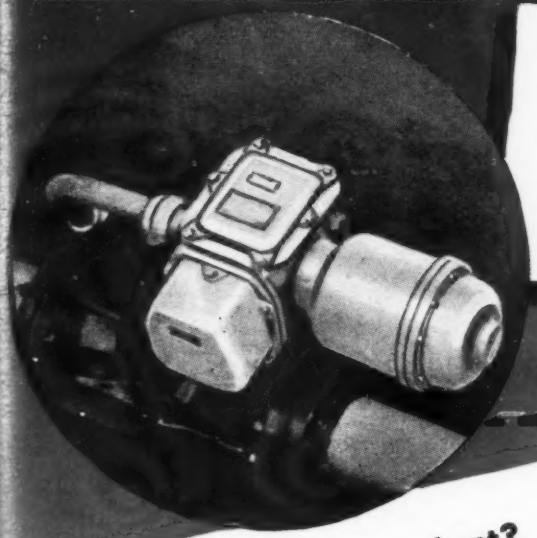


Fig. 1—Standard-fitted pump has cast-iron casing; bronze impeller, casing and impeller rings; bronze or cast-iron stage piece; steel shaft with bronze sleeve



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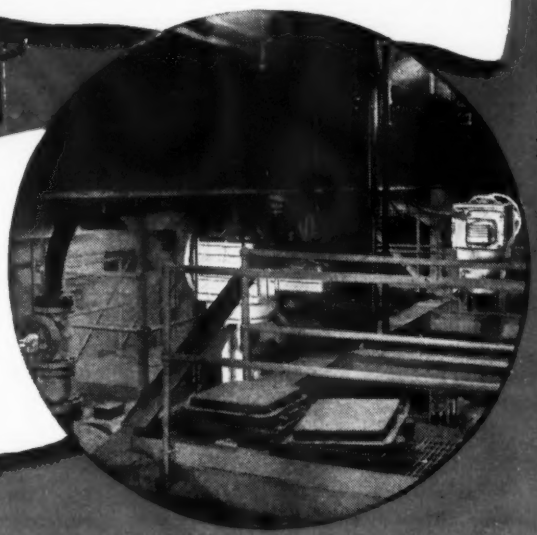

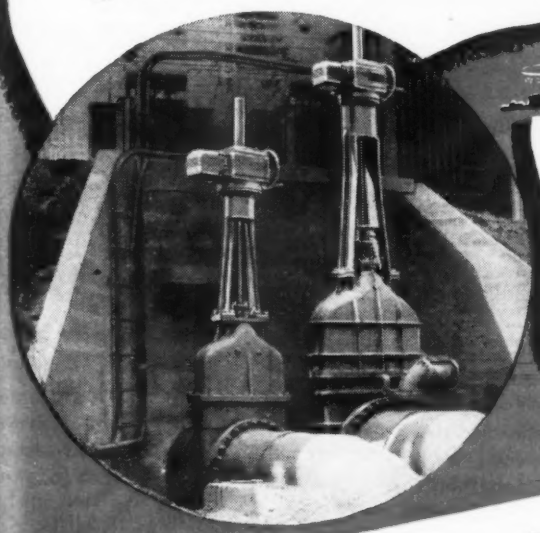

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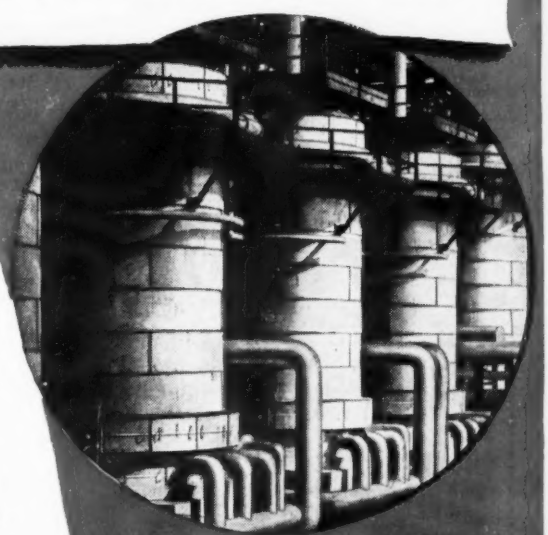

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PUMP Q&A *Continued*

stainless steel, phosphor-bronze, or monel shaft. Pump shafts without sleeves are generally stainless steel, phosphor bronze or monel, depending upon the liquid handled.

Q 7—What materials are used for shaft sleeves?

A—Most of them are made of bronze. When bronze is not satisfactory because of relative low resistance to abrasion, stainless steel is used. A few years ago, steel sleeves were more prevalent than stainless steel, but today stainless is superseding ordinary steel and in some services, such as boiler feed, even bronze as shaft-sleeve material.

A shaft sleeve that protects a shaft in a stuffing box must be made of a material that can be given a smooth finish for the packing. Thus, cast iron is rarely used for a shaft sleeve.

Q 8—What materials are commonly used for pump glands?

A—Glands are generally made of bronze although cast iron or steel may be used for all-iron-fitted pumps. Where pumps handle hydrocarbons, iron or steel glands are bushed with bronze to avoid possible sparking, which might ignite inflammable vapors.

Q 9—What is meant by pump fittings?

A—This expression is used rather loosely with two separate meanings. In the sense generally understood it refers to the general construction features of the pump as, for example, *ball-bearing-fitted pump*, or to the combination of materials used in the pump, as an *all-iron-fitted pump*. In a different category (as when applied in the expression *Underwriter fittings*), it may refer to various pieces of auxiliary equipment, such as valves, gages or even tools provided with the pump.

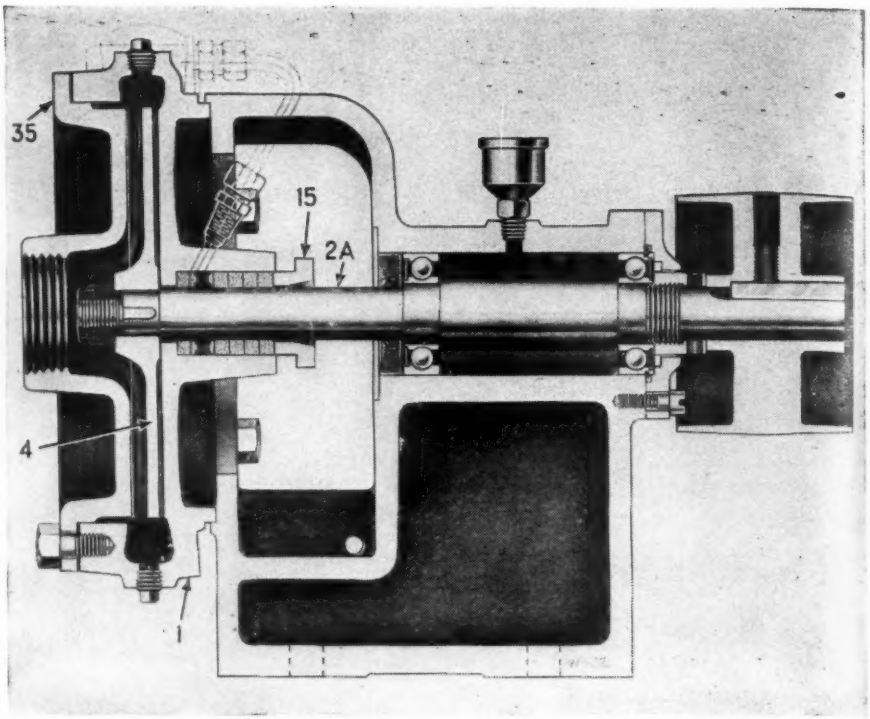


Fig. 2—End-suction single-stage centrifugal pump with semi-open impeller. Numbers in the table identify the materials from which the parts are made

Q 10—What is a standard-fitted pump?

A—The so-called standard-fitted centrifugal pump as defined by the Hydraulic Institute is bronze fitted. (See table and Fig. 1.) It has a cast-iron casing, steel shaft, bronze impeller and wearing rings and bronze shaft sleeves, when used. Some manufacturers regularly furnish stainless-steel shafts on pumps without shaft sleeves as standard-fitted pumps.

Various centrifugal-pump manufacturers have developed specific material for pumps designed for special services. When a pump is so constructed it is generally termed a *standard pump* although reference is sometimes erroneously made to *standard-fitted pump*, even though the materials do not correspond to the Hydraulic Institute definition.

Q 11—What is an all-bronze pump?

A—When all parts of a centrifugal pump that come in contact with the liquid pumped are bronze, the pump is considered an *all-bronze pump* (see table).

Q 12—What is an acid-resisting pump?

A—It is a pump in which all parts contacting the pumped liquid are of materials that offer maximum resistance to the liquid's corrosive action.

Q 13—What materials are used in centrifugal pumps handling sea or salt water?

A—Such pumps may be built with standard fittings, that is cast-iron casings and bronze trim, all iron, all bronze, or with iron casings and stainless fittings, depending on a multitude of factors.

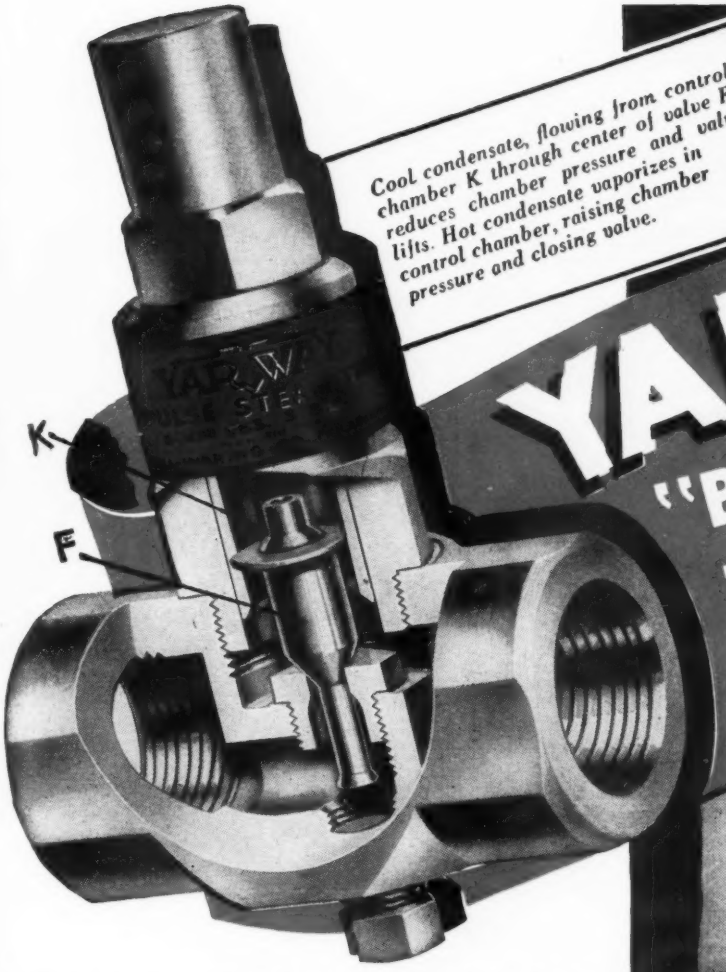
Thousands of standard-fitted pumps are used for sea water, but occasionally they give trouble, mostly when the sea water is contaminated, as with harbor waters. Failures are caused by galvanic action between the bronze parts and cast-iron casing which graphitizes and is ultimately a total loss. Under high suction-lift conditions, galvanic action is accelerated because oxygen is released from the water.

While an all-iron pump avoids the electrolytic action between bronze parts

Metals and Alloys for Centrifugal-Pump Construction*

Part No.[1]	Parts	Standard-fitted pump	All-iron pump	All-bronze pump
1	Casing	Cast iron	Cast iron	Bronze
35	Suction head	Cast iron	Cast iron	Bronze
4	Impeller	Bronze	Cast iron	Bronze
12	Impeller ring	Bronze	Cast iron or steel	Bronze
3	Casing ring	Bronze	Cast iron	Bronze
	Diffuser	Cast iron or bronze	Cast iron	Bronze
5	Stage piece	Cast iron or bronze	Cast iron	Bronze, monel or steel
2	Shaft (with sleeve)	Steel	Steel	Bronze or monel
2-A	Shaft (without sleeve)	Stainless steel or steel	Steel or stainless steel	Bronze
10	Shaft sleeve	Bronze	Steel or stainless steel	Bronze
15	Gland	Bronze	Cast iron	Bronze

* *Materials for bearing housings, bearings and other parts are not generally affected by the liquid handled.*
1 *Parts are numbered according to a proposed standard listing suggested to the Hydraulic Institute by Charles J Tullo, Worthington engineer. This proposed standard gives stationary parts odd numbers, and rotating parts even numbers, Fig. 1 and 2.*



Cool condensate, flowing from control chamber K through center of valve F, reduces chamber pressure and valve lifts. Hot condensate vaporizes in control chamber, raising chamber pressure and closing valve.

YARWAYS "BRING HOME THE BACON" AT GOLD MEDAL PACKING

These Yarway Impulse Steam Traps, installed on an Atmos Smokehouse at Gold Medal Packing Corp., Utica, N. Y., are but two of many Yarways doing an excellent trapping job for them on cookers, smokehouses, and hot water heaters.

Why is this company enthusiastic about the performance of Yarway traps? Just this . . . With Yarways on the job equipment gets hotter, sooner . . . and *stays hot!* When the condensate load is heavy, Yarways discharge *continuously* until lines and jackets are cleared. Then when the equipment reaches working temperature, discharge is *intermittent,* keeping it at peak efficiency.

Yarways have but one moving part—a small stainless steel, heat-treated valve . . . no floats, buckets, bellows or diaphragms. The trap body is machined from cold rolled steel bar stock and cadmium plated . . . rugged, built to *last.*

Straight-through piping and small size simplify installation and maintenance. Already, over 400,000 Yarways have been purchased. Frequently it costs no more for new Yarway Impulse Steam Traps than to repair old type traps. See your local Mill Supply Dealer or write for Bulletin T-1739

YARNALL-WARING COMPANY
100 MERMAID AVENUE, PHILADELPHIA 18, PA.

Have you seen "There Is An Engineering Reason"—new 30-minute color and sound motion picture with Lowell Thomas speaking? Now available for group showings. Ask for details.

YARWAY IMPULSE STEAM TRAP

and cast-iron casings, such action may occur nevertheless. A certain amount of iron dissolution may take place, leaving graphitized areas. They act as cathodes to the cast iron and the resulting galvanic action is self-accelerated.

To avoid graphitization and poor resistance to cavitation of cast-iron impellers, these along with other small pump parts may be of stainless steel. However, an all-bronze pump should give longest life for sea-water conditions. Certain all-bronze pumps have lasted over 20 years handling sea or harbor water.

Q 14—What is meant by graphitization?

A—If the liquid pumped chemically attacks the molecules of cast-iron pump parts and removes the products of corrosion, the action leaves a residue high in graphitic carbon. This phenomenon is commonly called graphitization. The relatively soft surface left exposed is readily washed away by jetting action of the water.

Q 15—Are there operating pressure and temperature limitations on the use of cast iron for pump casings?

A—Yes. For several reasons cast-iron castings are seldom used for pressures over 1000 psi and temperatures over 350 F.

Q 16—What is semi-steel?

A—There is no such metal. Ferrous metals must be either steels or irons and the difference between the two is strictly defined. The name has, in the past, been frequently applied to high-grade cast irons with a tensile strength of about 45,000 psi, halfway between the 30,000 psi of ordinary cast iron and the 60,000 psi of cast steel.

Q 17—Are there any temperature limitations on the use of bronze for pump fittings?

A—Because bronze expands about 40% more than steel and for other reasons, it is generally not used for pump fittings when the pumped-liquid temperature exceeds 250 F.

Q 18—Does the pH value of the pumped liquid affect the selection of pump materials?

A—While pH is not the only factor influencing material selection for pump parts, standard bronze-fitted pumps should not be used for pH values below 6.00 or above 8.5 at pumping temperature. Below 6.00, all-bronze pumps or stainless-steel-fitted pumps should be used, while above 8.5, the pumps should be all iron or all stainless-steel fitted.

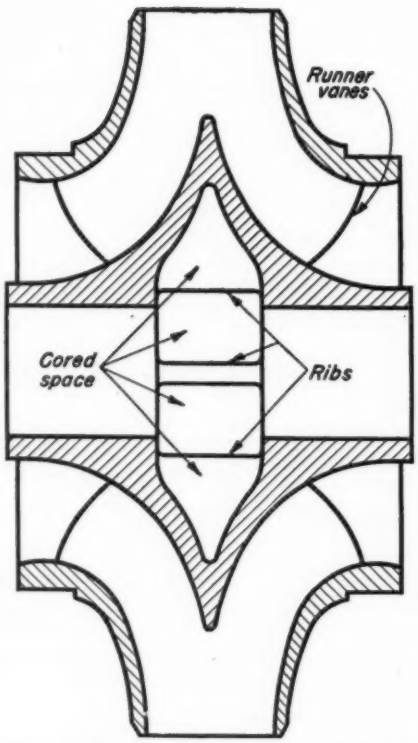


Fig. 3—Central hub of double-suction impeller is cored to improve the casting

Q 19—Why should dissimilar metals not be used in centrifugal pumps handling an electrolyte?

A—Severe corrosion may occur due to galvanic action between the metals immersed in the electrolyte.

Q 20—Does the choice of materials affect the clearances that must be used for adjacent pump parts?

A—In general, stainless steels have a greater tendency to gall than iron, steel or bronze. As a result, it is the practice to make running clearances between stainless-steel parts larger than for non-stainless metals.

Q 21—Why is the central hub of a double-suction impeller cored out?

A—It is generally cored out, especially in large impellers, Fig. 3, to avoid a heavy cross-section that might lead to porous and imperfect castings.

Q 22—Does the peripheral speed impose any limitations on the use of bronze impellers?

A—The centrifugal stresses exerted on an impeller and the resulting stretch at the impeller hub may become quite appreciable at high peripheral speeds used in modern high-head pumps. As an example, a typical 12-in. impeller mounted on a 3-in. shaft and operating at 3600 rpm has a stretch of about 0.0011 in. for bronze or cast iron. If the pump handles hot water, say at 250 F, there is an additional temperature-expansion difference between the impeller and its shaft of 0.0014 resulting in a total looseness of 0.0011 + 0.0014 = 0.0025 in. This looseness can easily lead to water cutting of the shaft under the impeller. To avoid the cumulative effect of excessive thermal and centrifugal expansion, the empirical limit to the use of bronze impellers in pumps handling hot liquids is a peripheral speed of about 160 ft per sec.

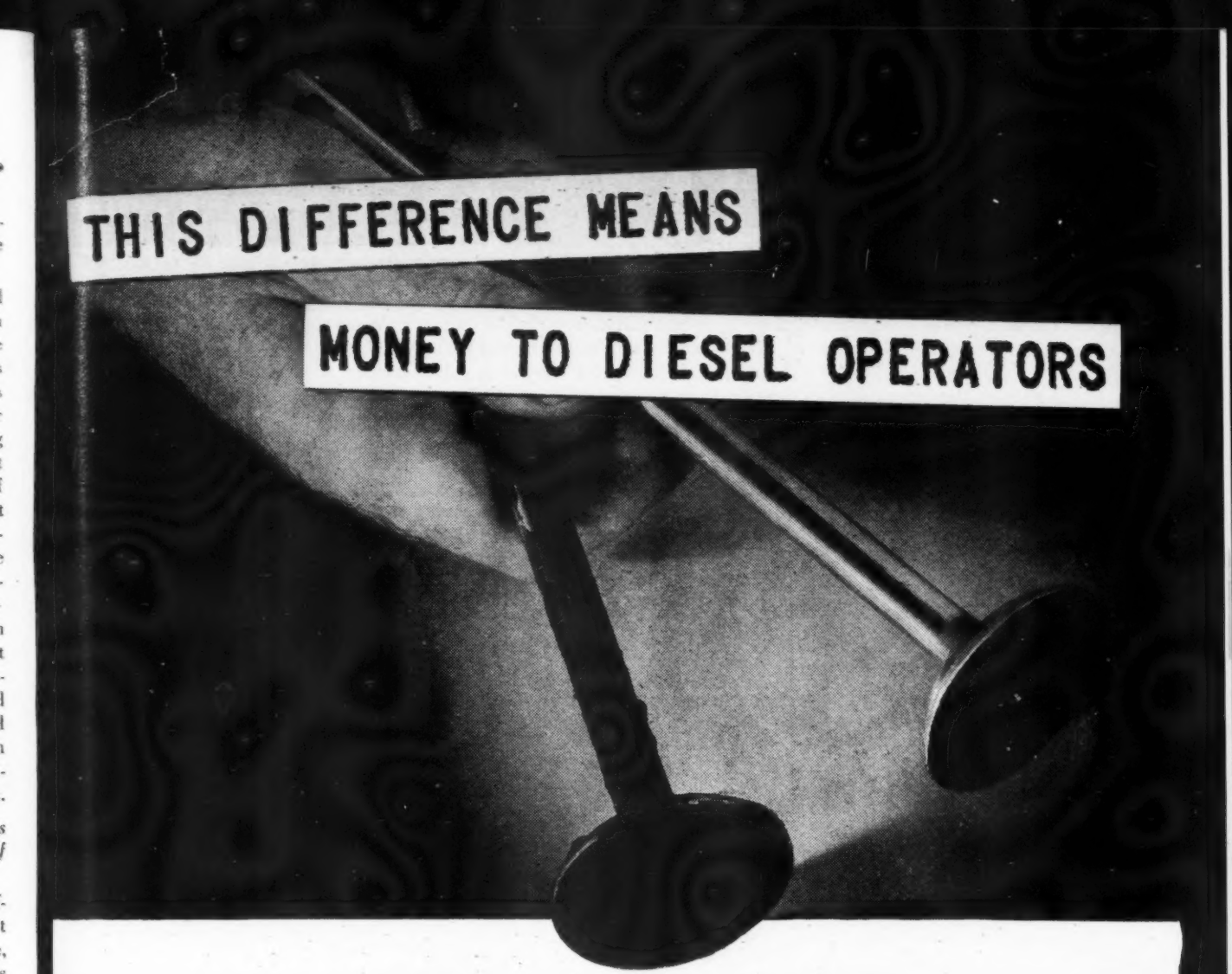
Q 23—How do the structural features of a pump's parts affect the choice of materials?

A—While choice of materials can often be made mainly from the viewpoint of corrosion and abrasion resistance, the structural features of a given pump's parts may play a definite role in the final material selection. Some parts, for instance, may require extremely thin wall sections, a material such as cast iron being unsuitable for these parts even though it may not corrode. Other parts such as shaft sleeves require a high degree of polish and only materials capable of receiving such finish should be used for them. Wherever the structural design requires pressed-on or shrunk-on parts, the material for them must be suitable for this method of mounting. For instance, when pump impellers have to be shrunk on the shaft, bronze cannot be used, selection being restricted to cast or stainless steel.

WHY PAPER IS A NO. 1 MATERIAL SHORTAGE

Over 700,000 Army and Navy items are wrapped, packaged, labeled, tagged or made from paper or container board. Pacific activities require stupendous amounts of paper and board since double and triple packing are required for protection against weather, insects, etc.

So please: (1) Share this magazine with your associates. Because of the paper shortage, the number of copies is limited. (2) Organize for a continuous drive in office and plant to collect waste paper of any kind to put into paper salvage. Clean out old files, dead correspondence, obsolete records, useless display materials, cartons, etc.



SUN DIESEL LUBRICANT... Ends Carbon and Gum Formation... Eliminates Sticking Valves... Lasts 50% Longer

Carbon and sticky deposits were black marks in the power-picture of an eastern candy-maker. In the operation of an eight-cylinder Diesel, direct-connected to an electric generator, he was using a well-known brand of Diesel lubricant which was changed every 200 hours.

Frequent shutdowns were scheduled for carbon-cleaning, for freeing stuck valves, and for general engine-repairs.

The difference in lubricants was soon proved when a Sun Oil Engineer studied the operating-conditions and recommended a Sun Diesel Lubricant for that particular type of Diesel engine.

Fifty percent increase in oil-life was noticed with the new oil in the crankcase. Oil-changes were soon scheduled every 300 hours instead of 200. Shutdowns for stuck valves, sticky deposits, and carbon-trouble due to faulty lubrication, were eliminated. These facts are typical of the results being obtained in all kinds of plants and all types of machines with Sun Industrial Lubricants and Sun Engineering Service. For power-equipment, compressors, machine-tools, hydraulic systems . . . in mills, mines, and factories . . . there's a Sun Product to help speed production and cut costs. Write for full details to . . .

SUN OIL COMPANY • ***Philadelphia 3, Pa.***

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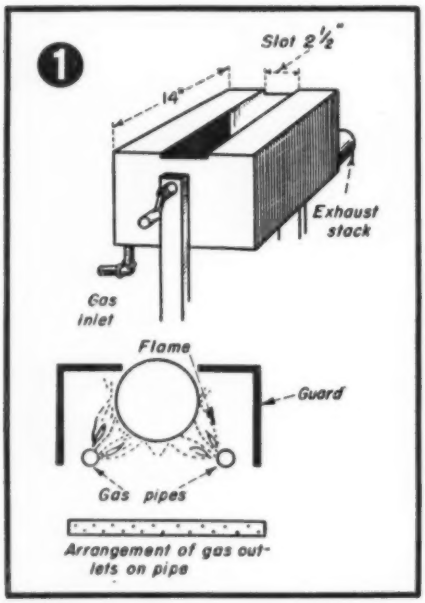
OILS FOR AMERICAN INDUSTRY

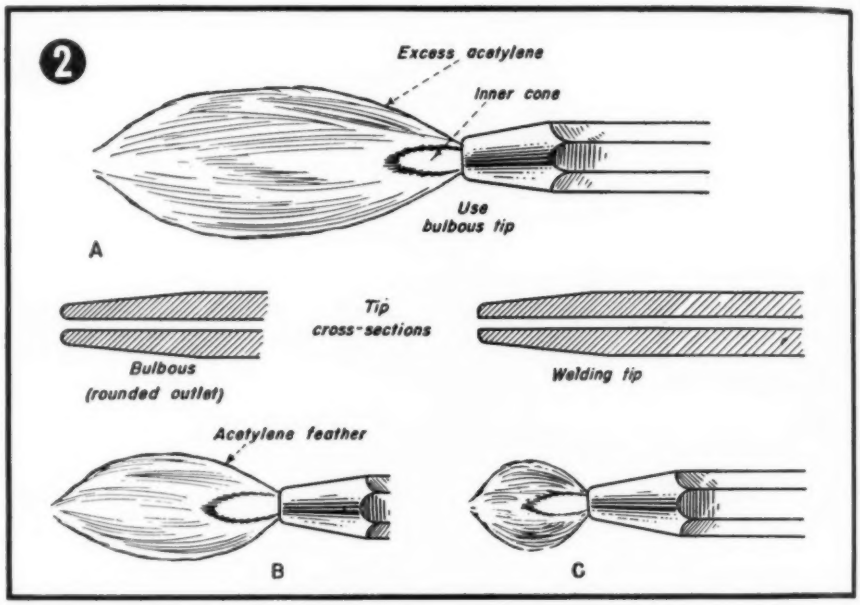
HOW TO HARD-FACE WITH ACETYLENE TORCH

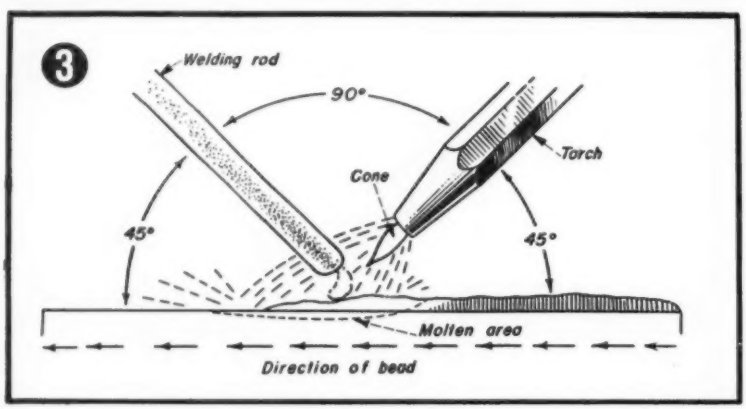
HARD-FACING means applying a hard alloy to the melted surface of a softer metal. Preheating is vitally important because it minimizes harmful internal stresses. Always heat the parent metal to 1500 F and maintain this temperature. To avoid a porous coating clean the surface thoroughly by grinding down to bright metal.

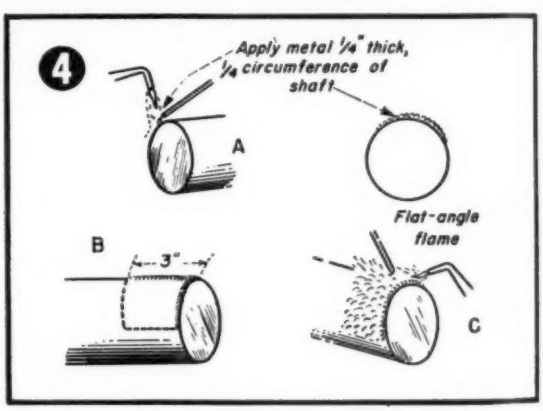
Good hard-facing metal has a high degree of fluidity, and application is best made on a horizontal surface. Thus some shapes must be rotated in a jig at uniform speed that matches the speed of applying the hard metal.

When parent-metal surface becomes fluid, melt hard-facing rod into the puddle, never allowing the rod to touch the surface. Such contact chills the steel and produces a porous coating. *Courtesy of the Mir-O-Col Alloy Co*









1 A gas oven can be built that maintains the part to be worked on at an even temperature. An asbestos covering protects the operator. A slot in the box top permits work on a steel shaft or other circular object.

2 Use a torch tip that produces a bulbous flame. Set the pressure regulators on both acetylene and oxygen tanks to maintain 10 psi. For an uncleaned surface adjust the flame so that acetylene feather is six times the length of inner cone *A*. A cleaned surface (ground) can be worked on with a shorter acetylene-feather flame *B*. For additional passes over hard-facing reduce acetylene feather as at *C*.

3 Hold torch so that flame strikes the work at a 45-deg angle, maintaining a 90-deg angle between torch and rod. Distribute and shape the deposit by manipulating the flame. If too much heat or acetylene is applied scum appears on hard-facing surface. Make full-depth deposit in one pass and maintain local heat until oxides are brought to the surface. Never touch cone of flame to work.

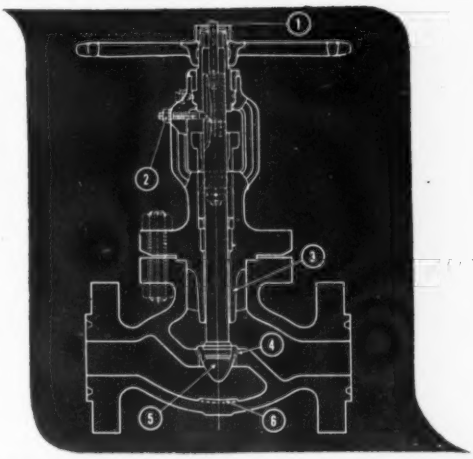
4 Start a bead on a shaft edge by holding torch at right angles to shaft *A*. Continue along the edge for one quarter of circumference. Return to starting point and lay another bead 3 in. in from the end, at right angles to the first, *B*. Continue back and forth until one quarter of the circumference is covered, *C*. Next, hard-face the diametrically opposite sector; repeat in small patches until done.

HOW EDWARD ENGINEERING LICKED THE THROTTLER VALVE PROBLEM FOR ONE COMPANY....

PROBLEM: Valves for throttling service have always been tough to build. The punishing wear of partly-open operation takes its toll on even the best standard globe type valve, and of course a gate valve in throttling service is seldom satisfactory. Not long ago a large Eastern utility came to Edward with a request for a valve specifically built for severe throttling service. Edward engineers, working with the customer, produced the valves described below. Originally designed for use on a feedwater pump by-pass line, they are ideally adapted to general throttling service.

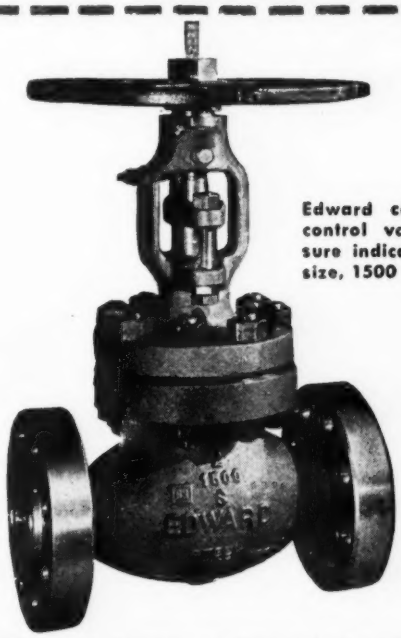
Here's what happens to even high quality valve parts in the most difficult type of throttling service. Notice how fluid, at high pressures and high velocities, has cut away the metal of the disk.

SOLUTION: Here is a valve with all the features that are important in throttling. An indicator **(1)** attached to the stem shows position of the disk at all times. An Alemite fitting **(2)** eases operation. A long stem guide **(3)** keeps the stem and disk in perfect alignment at all times. The seat **(4)** is a heavy layer of Stellite, applied directly to the valve body, and the disk **(5)** parabolic in design for volume control and integral with the stem, has Stellited seating faces, too. A bearing surface of EVinlay **(6)** on the valve body gives additional protection against high velocity flow. It is recommended that the valve be installed with pressure over the disk.



RESULT: The ideal steel valves for many types of throttling service. And, for other conditions and for various sizes of lines, Edward has solved the throttling valve problem with special materials and designs. This Edward engineering experience is yours to command.

EDWARD *Steel* VALVES
THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO, INDIANA



Edward cast steel flow control valve with closure indicator, in 2 inch size, 1500 lb ASA rating.

Look to Edward for the Best in New Steel Valve Developments

Look for Shoulders On Governor Pins

IT IS ASSUMED that the governor (Reader's Problems, April, 1945 POWER) is mounted on the flywheel and is the usual spring-and-weight type. With the spring disconnected, move the governor parts by hand to a position corresponding to any load from zero to full valve opening. At each point check the linkages and pins for sticky operation which may be caused by shouldered pins, eccentric holes, or parts not being parallel at all points.

At each load point, clamp the governor to prevent movement and bar the engine over one revolution, checking steam-valve operation as to point of opening, point of closing, and amount of opening. Trouble may be caused by mechanical faults, leaking valves, or faulty valve adjustment. If the governor is free at all points, and steam valve operation is correct, examine steam valves for leakage and refit them if necessary.

With a slide-valve engine the condition described by AF sometimes occurs if the steam-valve lap is incorrectly set or if the valve grid becomes shouldered through long service and the valve is reset to ride on this shoulder at no load. With poppet valves it is probably a case of improperly fitted governor or governor-linkage pins or leaking steam valves.

St. John, N. B. C G CLARK

Inspect Inertia Bar

IF THE GOVERNOR (April Reader's Problems) has an inertia bar with roller bearings without inner or outer races the rollers wear a groove on the surface of the pin and bearing lining. The grooves usually wear at the position of average-load speed; therefore, when the load is decreased to about 5%, or no load, the inertia bar is forced to an advanced position.

With this type of governor, if there are no grooves in the inertia bar the two spring-tension adjusting screws must be checked against the measurement stenciled on the edge of the flywheel rim or near the adjusting-screw bracket. If these springs do not have the same tension the engine will race.

Kansas City, Mo. LOUIS BURGGRAF

Converting Centigrade To Fahrenheit Scale

WHEN I BEGAN TO READ R J MacMeekin's quotation of the rule to convert Centigrade degrees to Fahrenheit, "Add 40, multiply by 1.8 and subtract 40" (POWER, March, 1945, page 124) I thought and hoped that he was going to state the fact upon which the rule is based. (Incidentally, I have never seen it in print although that may be my fault.) He didn't state it, so here it is: *At minus 40 deg both thermometers read the same.*

Remember that −40 C is the same temperature as −40 F. Hence the rule: Add 40 and you have the number of degrees above −40. Then multiply by 1.8. This gives the corresponding number of degrees on the Fahrenheit scale. Subtract 40 and you have Fahrenheit temperature. To convert from Fahrenheit to Centigrade divide instead of multiply.

Whenever I have to keep two things in mind, one of which is the opposite of the other, I do not bother about which is which. I remember only one of them. In this case: Multiply when converting deg C to F. Going the other way do the opposite.

San Diego, Calif. C A LEQUESNE

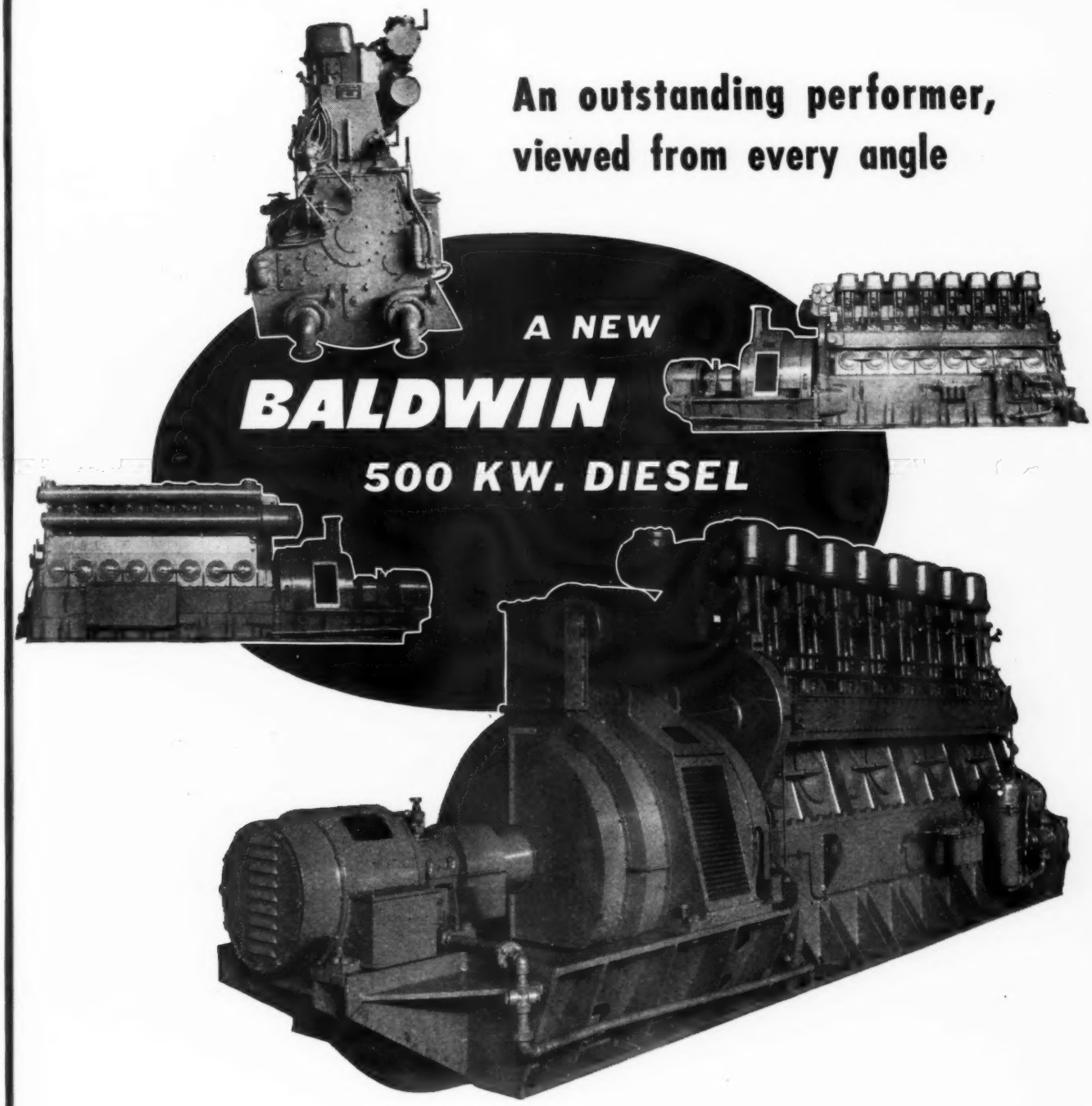
(*Continued on page* 140)

JUST HEARSAY

"Piccadilly Apartments, Combustion Engineer's Office: Mr. Murphy's secretary speakin' "

Reproduced with permission of New York Herald Tribune

An outstanding performer, viewed from every angle



This new engine, direct connected to a 500 kw. generator, will be used for auxiliary power in a Navy AR repair ship. Just one of many responsible jobs where the ability to deliver dependable power under severe service conditions is a Number One requirement.

In all types of service, the sound engineering and sturdy qualities of Baldwin Diesels are reflected in high efficiency, maximum availability, and minimum repairs. When you need a Diesel, check the Baldwin line; there's a type and size for almost every need.

The Baldwin Locomotive Works, Locomotive and Ordnance Division, Philadelphia 42, Pa. Offices: Philadelphia, Chicago, St. Louis, Washington, New York, Boston, San Francisco, Houston, Cleveland, Detroit, Pittsburgh.

BALDWIN PRODUCTS

Locomotives, Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Ship propellers, Marine steering gear, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

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BALDWIN

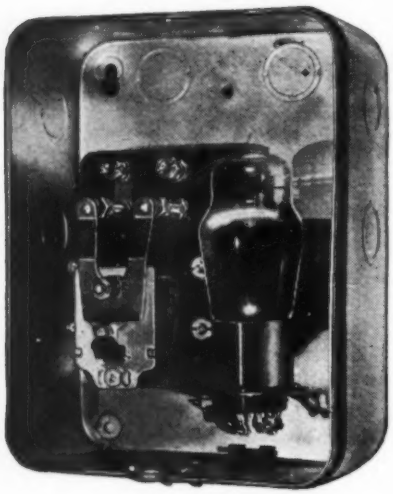
DIESEL ENGINES

WHAT'S New IN PLANT EQUIPMENT

Motor-Generator Set

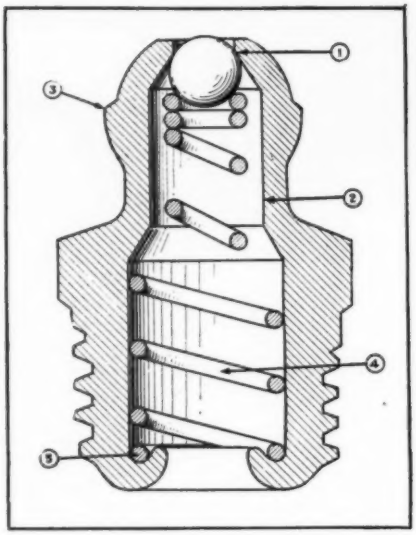
LIGHTWEIGHT AND SPACE-SAVING sealed 2-bearing motor-generator set has no sub base. Dripproof and shockproof, it is semi-inclosed and has five commutators and pair of

slip rings. It is for dc operation, but can be furnished with dc or ac driving motors. Set provides ac voltages and several different specified dc voltages from 12 to 2000 v. It has fine voltage regulation and meets low ripple requirements. Special terminal boards are contained in a shockproof housing mounted on top of unit for easy accessibility. **Bogue Electric Co, 40 Kentucky Ave, Paterson 3, N. J.**



Electronic Relay

GRID-CONTROLLED half-wave rectifier combines in one compact unit all the functions of a series of relays such as are commonly employed for control of outputs up to 30 amp. With only 100 microamperes in instrument circuit, 110 to 120 v, 50-60 cycle, ac up to 30 amp are controlled. There is no audible ac hum. Low-resistance fine silver contacts are adjusted easily or replaced. Coils are precision wound, impregnated and baked. Originally developed for *Princo* mercurial thermostats and thermoregulators, these relays are for a wide variety of industrial and laboratory control applications with such instruments as contact microammeters, pressurestats, photoelectric cells and similar apparatus. **Precision Thermometer & Instrument Co, 1434 Brandywine St, Philadelphia, Pa.**



Lubrication Fitting

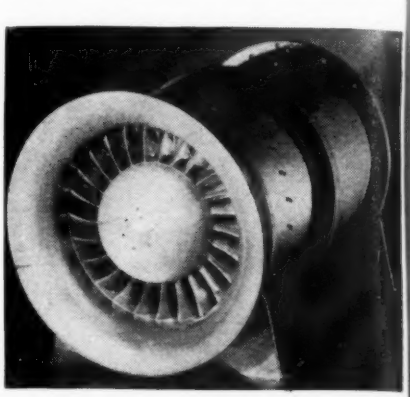
BULLNECK FITTING was especially developed for U. S. Army Ordnance Dept for heavy military combat and transportation vehicles. It was designed to incorporate the most desirable characteristics of various fittings heretofore used on ordnance equipment so as to permit standardization on one type. Only one kind of coupler is now needed for contacting the fittings, thus reducing lubrication equipment to a minimum.

Features of this fitting, shown in cross-section above, include: (1) Ball check is flush with fitting top, preventing dirt and foreign matter from lodging in the opening and being forced into the bearing. (2) New design provides a larger inside diameter, permitting greater volume of lubricant flow. (3) Bearing pad permits even distribution of wear on coupler jaws and fitting itself. (4) Inside diameter of passage in the fitting head is slightly less than diameter in fitting body, thus preventing ball-check spring from collapsing under pressure. (5) Fitting base forms an inverted ring-seat channel from which the ball-check spring cannot slip. This prevents spring from being forced through fitting. **Lincoln Engrg Co, St. Louis Mo.**

Compressors, Blowers, Fans

NEW DESIGN METHODS have been developed in line of axial-flow compressors, blowers and fans. Because of high capacity and small size of many of these units, it has been necessary to develop special motors, having high hp and small diameters.

Typical is the 14-in. blower shown, which delivers 8000 cfm and 10-in. sp, turning 3450 rpm. It is driven by an 8-in.-dia 20-hp motor. Complete unit weighs only 130 lb. Pressure and efficiency characteristics



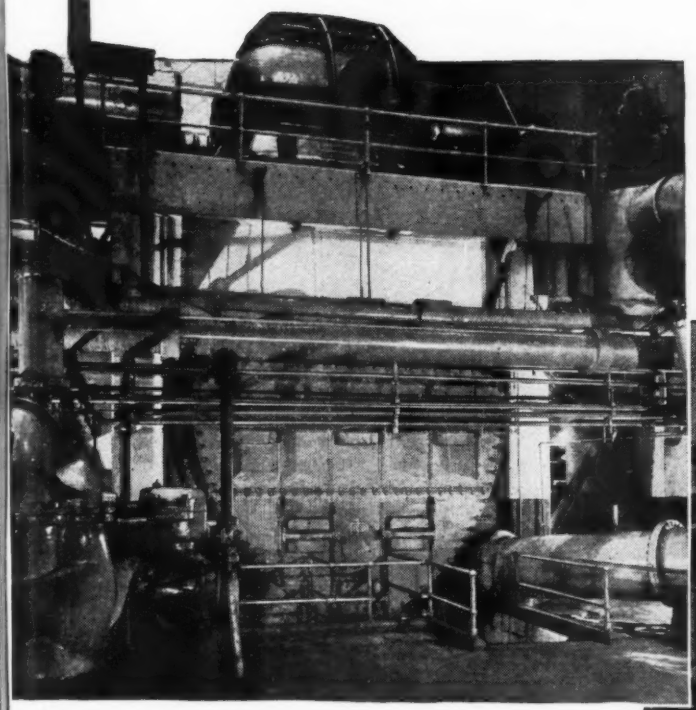
allow economical operation over a wide range. Noise level is low.

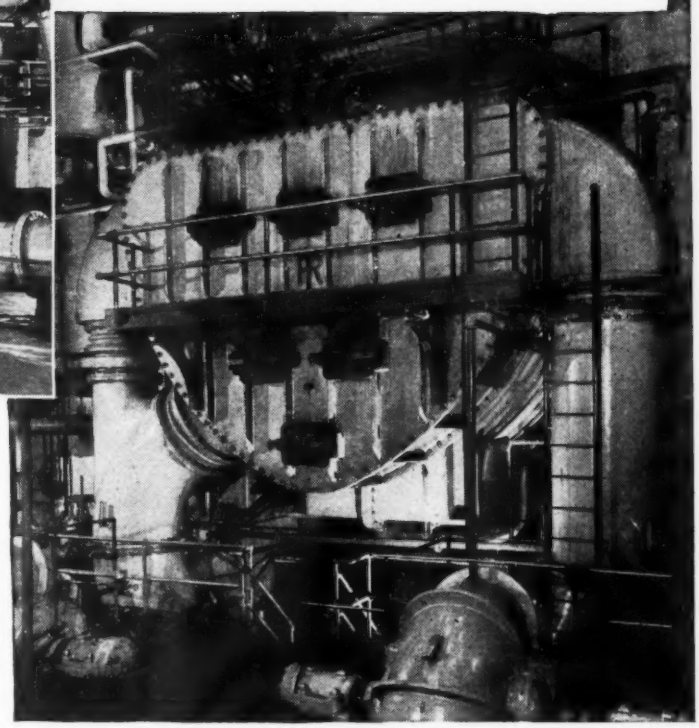
Line is to include a wide range of direct-driven units with air pressures from $\frac{3}{8}$ to 100 in. of water at synchronous motor speeds. Also direct-connected turbine-driven units up to 100 psi and 100,000 cfm will be available. **Buffalo Turbine Corp, 2165 Bailey Ave, Buffalo, N. Y.**

Photoelectric Control

CONSISTING OF photoelectric control Type A26X and light source Type L11RX, photoelectric system detects presence of smoke in air-conditioning ducts and immediately sounds alarms, turns off blowers, operates automatic dampers or provides whatever other indication or control is required. Light source Type L11RX may be mounted to project a light beam over any distance from 10 to 25 ft to "eye" of photoelectric unit. A sensitivity adjustment on light-source housing permits variation in inten-

again--- *Anaconda Tubes* render Outstanding Service





Two condensers at plant of Buffalo Niagara Electric Corporation, equipped with Anaconda Condenser Tubes. Upper unit: Capacity 34,000 sq. ft.—7,282 tubes installed in 1926. Lower unit: Capacity 45,000 sq. ft.—6,850 tubes installed in 1930.

In 1926 and 1930, the condensers illustrated were equipped with a total of over 14,000 Anaconda Condenser Tubes. Except for a few, damaged while cleaning one of the condensers, these tubes are still in service.

This outstanding performance emphasizes the economy of selecting condenser tubes to meet specific conditions. As an aid to such selection, The American Brass Company offers a two-fold service: First, technical assistance based on years of study of tube metallurgy under a wide range of operating conditions. Second, a wide variety of specialized condenser tube alloys.

As a step toward taking advantage of this service, write today for illustrated Publication B-2, "Anaconda Tubes and Plates for Condensers and Heat Exchangers." 45124

Keep Faith With Your Fighters and Yourself! Buy War Bonds

ANACONDA
from mine to consumer

Anaconda Condenser Tubes

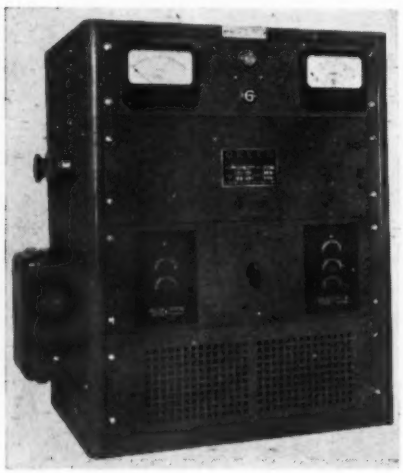
THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

EQUIPMENT *Continued*

sity of light beam and may be set so that photoelectric control will respond to smoke of a predetermined density. Type A26X will then remain inoperative at any other level of illumination, but will be actuated when smoke haze sufficiently reduces amount of light reaching phototube. To provide complete protection, Type A26X is so designed that either current or tube failure will cause control to operate as though light beam were interrupted.

Both units are available either in explosionproof housings or in weatherproof pressed-steel housings. Type A26X operates from a supply of 115 v, ac, 60 cycles, and incorporates a single-pole double-throw relay for normally open or normally closed operation. Relay contacts are pure silver, designed to handle 10 amp ac or 5 amp dc at 115 v. When using external power, a maximum of 230 v may be utilized on contacts provided 1100 watts ac or 550 watts dc is not exceeded. Larger currents or higher voltages may be controlled through an auxiliary power relay. **Photoswitch, Inc, 77 Broadway, Cambridge 42, Mass.**



Low-Voltage Rectifiers

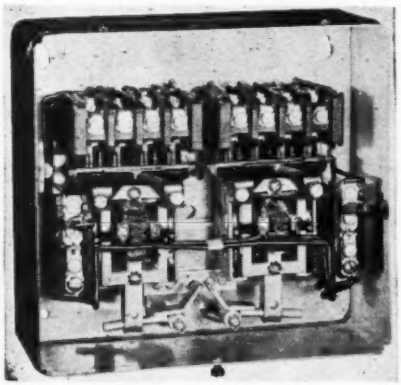
UNIT SHOWN ABOVE is rated at 200 amp, voltage range zero to 3 v. Any voltage selected in range is maintained to within 50 millivolts over load variation from zero to 200 amp and with line-voltage variation of ±10%. Voltage stabilization system includes motor-driven powerstat and simple electronic pilot device. Principle is applicable to larger or smaller rectifier units. **Green Electric Co, 130 Cedar St, New York, N. Y.**

Hydraulic Packing

WEATHERHEAD T-RING PACKING consists of a resilient sealing ring of synthetic rubber in a T-section backed up or supported on side by two nonextrusion ring retainers or guards. These rings are split and made of laminated phenolic material. Simple installation is such that synthetic rubber member is under slight compression, which provides the static seal. When operating pressure is increased, flange of packing expands radially against nonextrusion rings, thus holding them in contact with surface of cylinder or piston rod. This action prevents sealing material from being damaged by extrusion into the clearance space between mating parts. Packing is available for piston or piston-rod assembly. **Weatherhead Co, 300 E 131st St, Cleveland, Ohio.**

Reversing Starter

NEW AC MAGNETIC REVERSING STARTER features a semi-interference mechanical interlock. Available in sizes 0 and 1, starter is for full voltage starting of squirrel-cage induc-



tion motors, although it can be used for reversing service when combined with a reduced voltage starter.

Easy to adjust, semi-interference mechanical interlock prevents closing of one contactor while an arc is maintained on the other, thus averting a short circuit through the arc and resultant burned contacts and blown fuses. In addition, interlock arm of closing contactor assists interlock arm of opening contactor in reaching its fully opened position.

Other features incorporated in this starter are under voltage protection when used with a push-button station or other momentary pilot-circuit device, undervoltage release when used with selector or limit switches and tamperproof self-contained overload relays which allow motor to operate up to its maximum safe temperatures before tripping it off the line. Starter is housed in a sturdy metal inclosure with a hook-on cover. Dust-tight and water-tight inclosures are furnished where special conditions warrant. **General Electric Co, Schenectady, N. Y.**

Circuit Tester

ALL-PURPOSE CIRCUIT TESTER indicates voltages from 90 dc and 60 ac to 500 ac or dc. General Electric neon lamp on top glows in varying intensities indicating circuit conditions. No glow indicates a dead line. Lamp lights on currents as low as one microampere. New tester is for locating blown fuses, trouble-shooting in cords and appliances, testing radio frequency, receivers, plate circuits, screen grids, spark plugs, meters, condensers, armatures, etc. **Amerline, 1753 N Honore St, Chicago, Ill.**

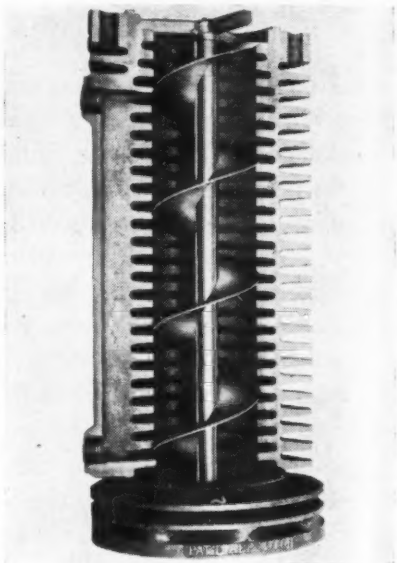
Electrodes

FOR SPEEDY AND ECONOMICAL WELDING in all positions and with ac and dc reverse polarity, the new ACP electrode is available in seven diameters from $\frac{5}{32}$ to $\frac{3}{8}$ in. Heavily coated electrode, for high-quality welds on work which is not easily positioned, forms a light, porous slag which is removed from each pass easily by light brushing. Because of high tensile strength and ductility of welds made with ACP, this rod is especially suited for heavy-plate fabrication, shipyard, pressure piping, pressure vessels and general structural-steel work.

Easy to handle on vertical and overhead work, ACP produces excellent results in making horizontal fillet welds and lap joints on all low and medium carbon steels, as well as low alloy and cast steels. **Westinghouse Electric Corp, Pittsburgh, Pa.**

Snap Switch

JUNIOR SWITCH is only $\frac{9}{16}$ in. dia and $\frac{31}{32}$ in. long over-all. Switch is complete in itself but can also be furnished with special over-travel adapters and mounting sockets. A pressure of 4 psi operates switch. *Junior* can be furnished normally open, normally closed, two circuits or single-pole double-throw. It is supplied with a nut and lockwasher—the mounting thread is $\frac{1}{2}$-32. Where switch is screwed into an over-travel adapter the thread of the adapter is also $\frac{1}{2}$-32, although other threads may be supplied where necessary. **Robert Hetherington & Son, Inc, Sharon Hill, Pa.**



Temperature Exchanger

BIRD-WHITE TEMPERATURE EXCHANGER, based on principle of heat transfer for air and gas lines, offers as a byproduct external heating applications and positive purification by centrifugal action.

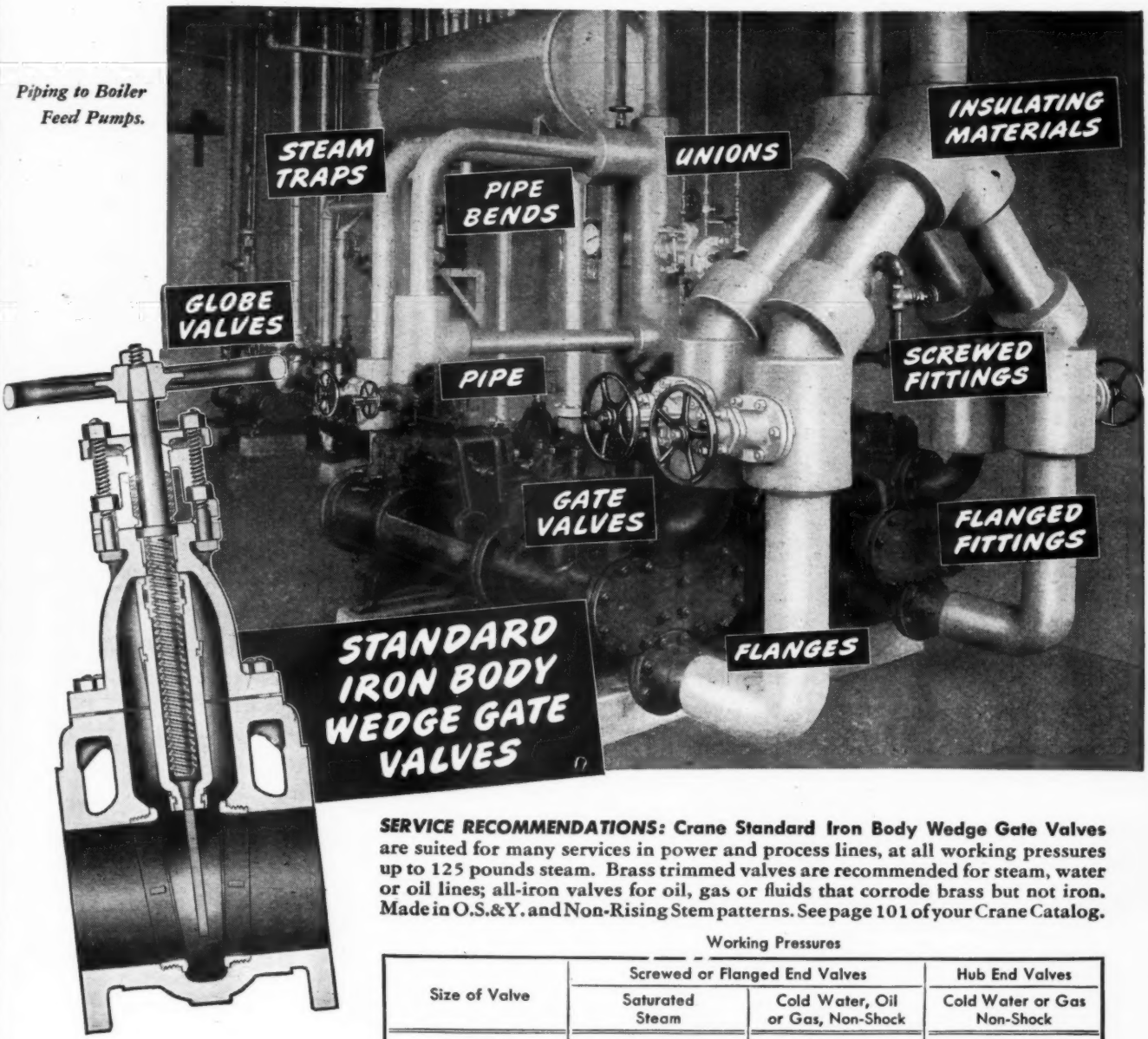
This unit, as an aftercooler, is recommended for installation at compressor discharge point. Liberally supplied with ex-

(*Continued on page* 158)

IT'S CRANE
. . . For ALL Piping Materials

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY • ONE STANDARD OF QUALITY

By choosing Crane piping materials, you always have the advantage of the world's greatest selection—in brass, iron and steel. One source—your Crane Branch or Wholesaler—takes care of all your requirements. Thus, you are assured of uniform quality in all parts of piping systems—with single responsibility behind them. And because Crane complete piping material service simplifies ordering, it speeds up deferred replacement work . . . helps keep piping at peak efficiency. A typical Crane solution for many of your valve application problems is shown below.



Piping to Boiler Feed Pumps.

SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** are suited for many services in power and process lines, at all working pressures up to 125 pounds steam. Brass trimmed valves are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S.&Y. and Non-Rising Stem patterns. See page 101 of your Crane Catalog.

Working Pressures

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2-in., use Crane Clamp Gate Valves.)

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

90 YEARS OF PROGRESS 1855 1945

VALVES • FITTINGS • PIPE

PLUMBING • HEATING • PUMPS

Engineering-Wise . . .

In "Curiosity" (POWER, July) I said I was going to try to find out why one red-winged blackbird had only the yellow bar—and not the red shoulder—on his wings, and why a red-white-and-blue fly alone took trout on the Fourth of July. J C Runyon, consulting engineer of Falls Church, Va., suggested I read Genesis XXX: 37-41, describing Jacob's trick with peeled wands of chestnut and other woods, to make all his father-in-law's animals produce spotted and speckled offspring—Jacob having thoughtfully suggested in advance that solid-color animals stay in his father-in-law's herd, while he got the off-color ones. Says Mr Runyon: "To me it is a source of wonder that these old boys knew so much that today's scientists are still searching out."

Down on the farm, we were told that stones in a pasture would cause spotted calves —probably some "old boy's" smart method for getting the pasture cleaned up. But seriously, we who have become so engineering-wise are still stumped by some of the engineering accomplishments of the little brown men of ancient Egypt, for example. Here are a few cases in point:

Our finest linen has 150 warp threads per inch. Some Egyptian mummies were wrapped in linen with 400 warp threads per inch.

Basis of Egyptian measurement was the cubit—length of the forearm from elbow to tip of middle finger. With that, they built the pyramids so exact for rectangularity and dimensions that modern surveying instruments detect no error.

In the Metropolitan Museum of Art, New York, I saw a falcon head, slightly less than natural size, wrought in gold. *Each feather* was a separate leaf of gold, properly veined and marked, the whole assembled by silver soldering so skillfully that the solder shows only under a magnifying glass.

In the same museum is a fragment of the head of Queen Nephretiti, carved in yellow jasper, a stone so hard that steel won't touch it—mechanics at the museum drilled half a day with a brass tube and emery to get a mounting hole $\frac{1}{2}$-in. deep in the neck for a $\frac{1}{2}$-in. dowel. Around the mouth of that head is an outlining bead about $\frac{1}{16}$ in. across, too fine for forming by abrasion with sand, so obviously formed with a tool. But the Egyptians at that time didn't even have steel!

I could go on, but I think you get the idea. As engineers, the little brown men still have a couple of things on us. But to keep them in their place, too—their most elaborate labyrinth, in the Great Pyramid, was solved, and the tombs robbed, by ignorant desert Arabs within 400 years—Arabs who knew Hercules' trick of using a ball of string. Again, you'll recall that a fellow named Moses destroyed their armies. He crossed an arm of the Red Sea just before a heavy wind and tide—the armies were caught by it. Of course, Moses had spent part of his boyhood in the area, which was far more dependable than the Egyptian G-2 (Intelligence).

In short, no civilization is completely engineering-wise—*yet*.

George Edwards

Engineer

Bosses of the Btu . . .

Tight fits in tight spots . . . another investment in J-M Insulations that is destined to pay off as planned.

. . . their skill is your protection against the pitfalls of poorly applied insulation

PITFALLS in insulation application are many —and costly. Costly in money through wasted fuel . . . costly in operating efficiency through inadequate heat control.

To assure proper application of its insulating materials, Johns-Manville recommends the engineering skill and expert workmanship of organizations especially set up for this work. In some areas the groups are Johns-Manville's own construction forces. In others, they are J-M Technical Service Units—contracting companies carefully selected for their integrity and background in this field. Each of these organizations is responsible for handling all details of an insulation job—a complete carry-through from planning to application.

Through generations of research, Johns-Manville has developed a line of insulations that spans the entire range of industrial temperatures and fits every service requirement.

* * *

If you have an insulation problem, why not call on J-M for the solution? Write Johns-Manville, 22 East 40th St., New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

JOHNS-MANVILLE *First in* INSULATIONS

POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

FOREIGN FIELDS • MODERNIZATION • FUEL CONSERVATION

POWER EDITORS LINE UP FOR BROADER POSTWAR SERVICE

STANLEY A TUCKER, formerly associate editor of POWER, has been appointed McGraw-Hill European engineering editor with headquarters at McGraw-Hill London office, Aldwych House, London WC 2.

While the parent company thus pioneers an international service for the business and engineering readers of all of its 24 publications, POWER, on the home front, engages three experienced power engineers as assistant editors. Bernhardt G A Skrotzki takes over Tucker's specific responsibility for articles dealing with the technology of utility power plants. John L King and Joseph C McCabe bring new, practical service to industrial power engineers.

Before reaching the London office, Mr Tucker is spending a month in Switzerland for POWER, gathering information on Swiss developments in gas turbines, heat pumps, steam turbines, refrigeration and similar lines.

Following are brief biographical sketches, together with photos, of Messrs Tucker, Skrotzki, King and McCabe.

Tucker in Europe for McGraw-Hill; Skrotzki, King and McCabe Join POWER Staff

STANLEY A TUCKER

B G A SKROTZKI

JOHN L KING

JOSEPH C McCABE

STANLEY A TUCKER An honor Yale electrical engineering graduate (1926) Stanley Tucker's engineering experience was almost entirely in the field of mechanical engineering and closely associated with the design and construction of Hudson Avenue and Waterside Stations.

After completing Brooklyn Edison's cadet engineering course, Tucker entered the mechanical engineering dept as an engineer in the general engineering div. He shortly became division engineer, a position he held until the merger of the Edison engineering staffs, early in 1937.

He has been with POWER as associate editor since August, 1937, devoting his time largely to utility steam-plant problems. He prepared the first article on the modern gas turbine to appear in the technical press and since that time has become known as an authority in this field.

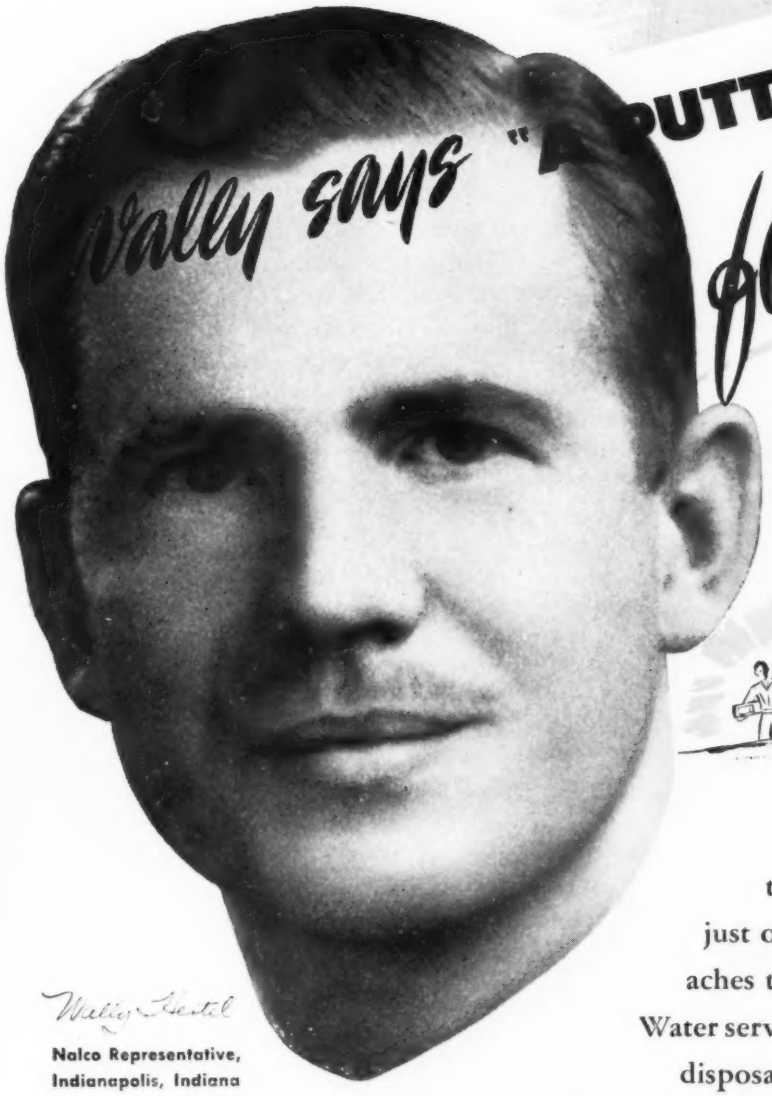
BERNHARDT G A SKROTZKI With degrees in electrical and mechanical engineering, Ben Skrotzki, assistant editor, takes over Tucker's responsibility for articles relating specifically to the design, construction and operation of central power stations. His preparation for this work includes 22 years of utility experience with Brooklyn Edison and Consolidated Edison Co of N. Y. Starting as technical clerk, Skrotzki later served as laboratory assistant, junior engineer, cadet engineer. Since 1937 he has been assistant engineer, system engineering dept.

His operating experience emphasized performance records, metering and control, equipment testing, etc. In the system engrg dept he studied the feasibility and economics of proposals for developing central-station supply of electrical and steam energy and related problems. He is co-author of new text, *Applied Energy Conversion.*

JOHN L KING Born and raised in the Southwest, John L King, assistant editor, is an electrical engineering honor graduate of the Texas Technological College. After post-graduate study with General Electric, he did engineering work at the Panama Canal until November, 1944. There he supervised electrical design of automatic diesel power plants and other special equipment. King comes to POWER from War Emergency Pipe Lines, where he was electrical engineer, supervising all electrical work and maintenance on the eastern half of "Big Inch," including engineering and supervising maintenance and construction. On POWER he will devote himself to engineering problems of industrial power plants.

JOSEPH C McCABE Coming to POWER as assistant editor in the Fall, Joseph C McCabe of New Jersey brings

(*Continued on page* 194)



Walley says "A PUTTER IS OK for putting . . . but it takes a complete set of clubs to play the game right"

Walter Gentil
Nalco Representative,
Indianapolis, Indiana

. . . and the same holds true when it comes to water treatment . . . it takes more than just one chemical to banish the headaches that accompany untreated water. Water service engineers should have at their disposal a wide range of water treating chemicals to choose from in order to prevent scale, corrosion, foaming and algae. . . . Nalco water treatment goes right to the heart of the trouble and *eliminates it once and for all!* It is an exact science. Let us show you what Nalco can do for you. Ask for a Nalco survey today.

Photo in Nalco Laboratories

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

How to plan

CHILLED WATER AIR CONDITIONING UNIT CONNECTIONS

Another in the series of basic Piping Layouts prepared by Jenkins.

Larger air conditioning installations employ the indirect, chilled-water-in-coils system more often than the refrigerant type, especially in buildings such as theaters, department stores and depots. Many cities have building codes that require chilled-water-in-coils systems, in the interest of water conservation.

Normal operation of these systems is accomplished by the use of a three-way modulating valve which automatically changes the proportion of water which passes through the unit and that which by-passes around the unit. Other valves are placed so that, in the event of failure of the modulating valve, the unit can be shut off for repair or switched to manual regulation. The total quantity of chilled water is regulated by the setting of the lock shield globe valve.

Humidification for winter operation is provided by means of a by-pass around the automatic humidifying valve. The layout also shows control valves recommended for the air lines of the pneumatic system.

Many types and pressure ranges of Jenkins Valves, other than those mentioned, may be used – according to the nature of the particular installation. Jenkins recommends consultation with accredited piping engineers and contractors, when adapting these suggestions to your own requirements, or when planning any major piping installations.

Copies of this layout will be furnished on request by Jenkins Engineers. If you would like, in addition, copies of future "Piping Layouts", as they appear, just fill out and send the coupon below.

Jenkins **PRACTICAL PIPING LAYOUTS**

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

1. **Place valves correctly in the line.**
2. **Use the right type valve for the service.**
3. **Choose Jenkins Valves for lifetime economy.**

4

Fig. No. 368, an Outside Screw and Yoke Bronze Gate Valve, is used extensively in the accompanying layout because of the advantage of the rising spindle, which shows the amount of valve opening. The outside threads are easy to clean and lubricate. A pin, which will not shear or corrode in service, secures the wedge to the spindle. However, although this type is preferred, an Inside Screw-Traveling Spindle type can be substituted.

OVER 600 DIFFERENT VALVES TO FIT YOUR PLANS.

For any piping layout, you will rarely need a valve not listed in the Jenkins Catalog.

Select the valves you need from this one convenient source. You save time, and you get the advantage of Jenkins *better* design, *better* materials, *better* workmanship and specialized valve-engineering experience. You pay no more for Jenkins *lifetime quality* than for other good valves.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta, Boston, Philadelphia, Chicago, San Francisco. Jenkins Bros., Ltd., Montreal, London.

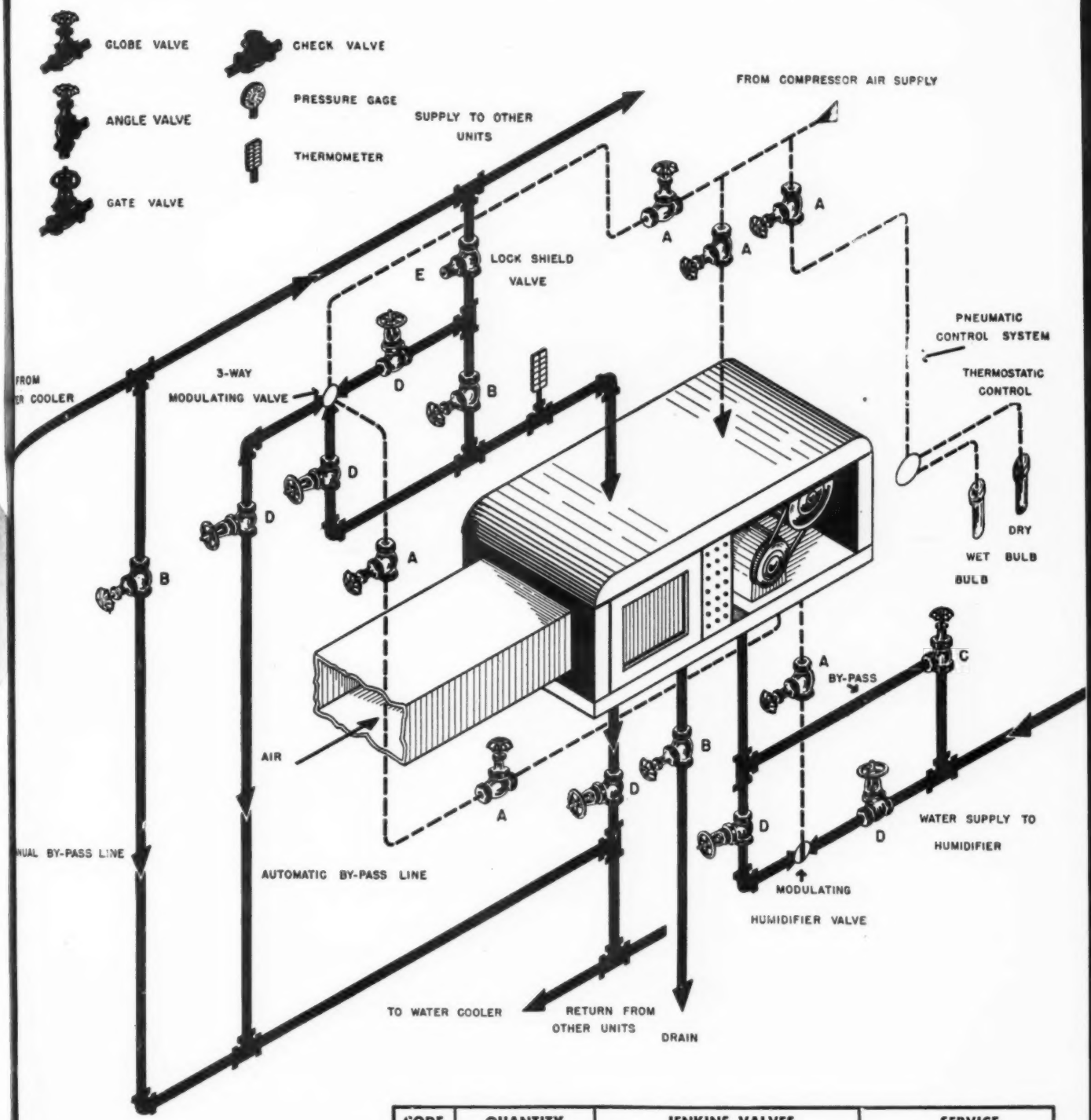
JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864

125 TO 600 LBS. PRESSURE

CHILLED WATER AIR CONDITIONING UNIT CONNECTIONS



ALVE RECOMMENDATIONS

letails – and valves to suit vary-onditions – see Jenkins Catalog.

CODE	QUANTITY	JENKINS VALVES	SERVICE
A	6	FIG. 106-A BRONZE GLOBE	CONTROL AIR LINES
B	3	FIG. 106-A BRONZE GLOBE	CHILLED WATER LINES
C	1	FIG. 108-A BRONZE ANGLE	CHILLED WATER LINES
D	6	FIG. 368 O.S.&Y. GATE FIG. 47 T.S. GATE	CHILLED WATER LINES
E	1	FIG. 106-A LOCK SHIELD GLOBE	CHILLED WATER LINES

Diagram by Huxley Maddcim, Cons. Eng.

BRONZE ★ IRON ★ STEEL

RY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING-HEATING SERVICE
OLD THROUGH RELIABLE INDUSTRIAL DISTRIBUTORS EVERYWHERE

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Please send me a reprint of Piping Layout No. 4, and future reprints as they become available.

Name _____

Company _____

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POWER'S DATA SHEETS

Number 157

Flue-Gas Velocity Chart

► GAS VELOCITIES are calculable if the velocity head, temperature and molecular weight are known. From the spouting-velocity formula, $v = \sqrt{2gh}$, and the general gas equation, $PV = 1544T/m$, the gas-velocity formula, $v = 15.66\sqrt{TD/m}$, is derived, where v = velocity, feet per second; g = gravitational constant; h = head of gas, feet; T = absolute temperature, degree Rankine; D = gas velocity head, inches of water; m = gas molecular weight.

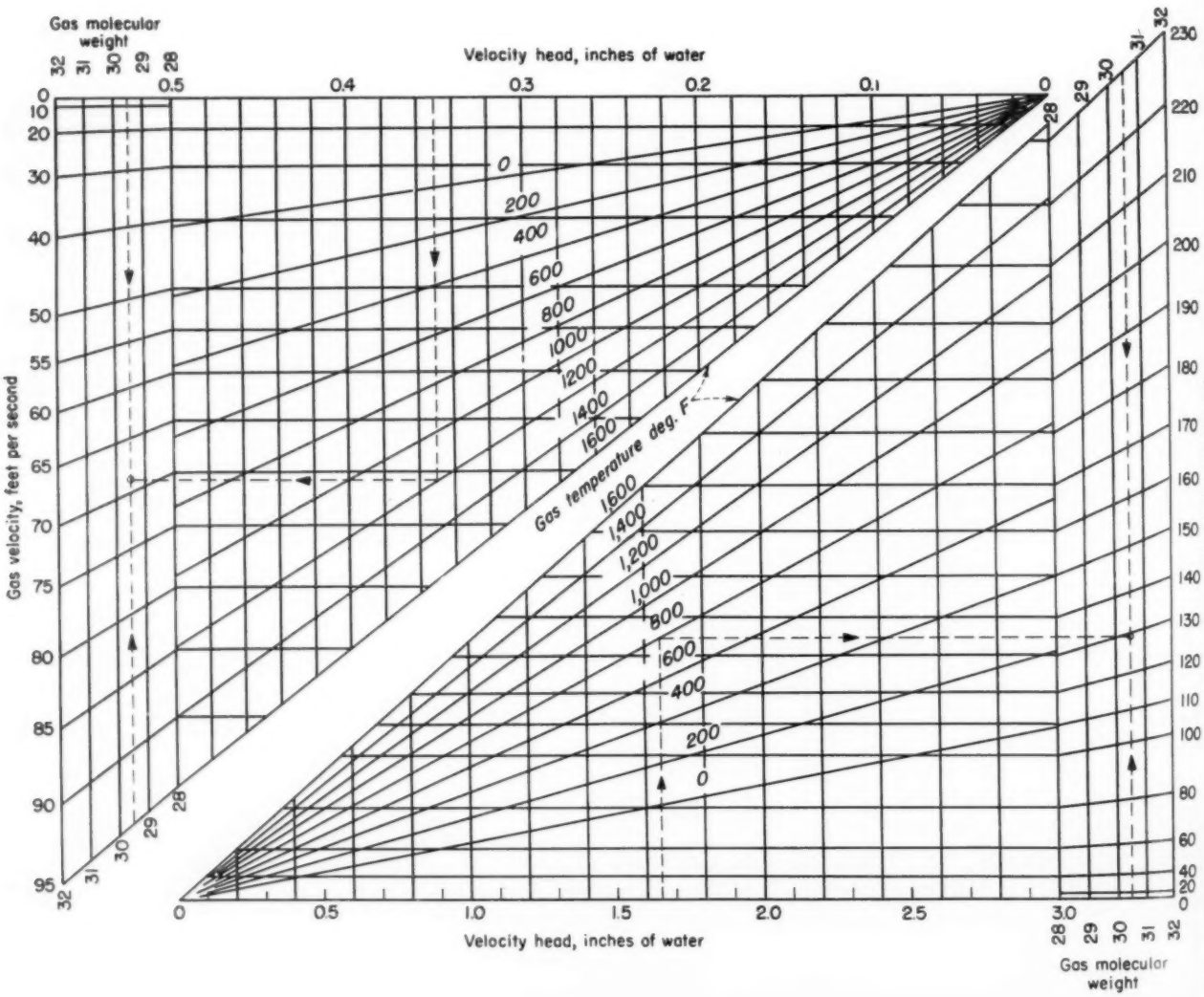
This chart is computed for gases at atmospheric pressure. Velocities are about 1.3% lower for each 10-in. H_2O increase in static pressure. The range of molecular weights from 28 to 32 applies to most of the common flue gases. For instance, the molecular weight of the flue gases from carbon burned completely in zero excess air is about 31.4; when burned completely with 25% excess air the molecular weight is about 30.9. When methane is burned completely in zero excess air the flue-gas molecular weight is 27.6, compared with 27.9 for 25% excess air.

The upper triangular chart is a magnification of the toe of the lower triangular chart from 0- to 0.5-in. H_2O velocity head.

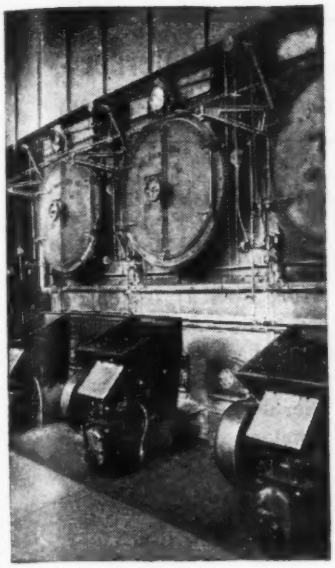
Example (*upper chart*): With a gas at 1200-F temperature and traveling with a 0.35-in. velocity head, what is the gas velocity if the molecular weight is 29.5? Follow dashed line to find answer of 69 fps.

Example (*lower chart*): Given 1.65-in. velocity head, 800-F temperature and 30.5 molecular weight, find the velocity. Follow dashed line to 129 feet per second.

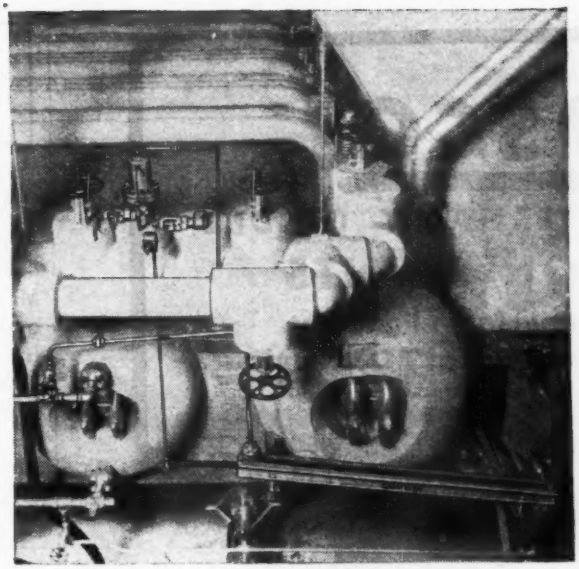
By R B Boals



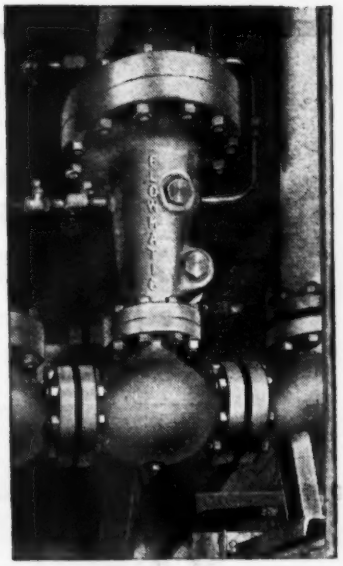
© POWER



Atlanta Ice & Bottling Co., Atlanta, Georgia. 3 Copes Type OT Regulators installed on HRT Boilers operating at 100 pounds pressure.



Industrial Plant. One of two feed lines to 650-pound pressure C-E Boiler handling a peak of 150,000 pounds per hour, controlled by a Copes Type BI Regulator and Type 3-S-2 Differential Valve.



Eddy Paper Corp., White Pigeon, Mich. Direct-operated Copes Flowmatic Regulator Valve on 550-pound Badenhausen Boiler.

There's a COPES *Feed Water Regulator* FOR EVERY BOILER REQUIREMENT

SMALL BOILERS?

For HRT, Scotch Marine, and other small boilers, the Copes Type OT Regulator is ideal. Extremely simple, easy to install, compact, direct operated.

Sizes ¾" to 2", 250 and 300 lb. stds.

WATER TUBE BOILERS?

For the conventional water tube boiler subject to ordinary loads, the Copes Type BI Regulator is universally the best known simple level regulator. Fully automatic, thoroughly reliable, smooth acting. Direct or relay operated. Sizes ¾" to 8" all pressure stds.

SENSITIVE BOILERS?

For boilers subject to severe load fluctuations or those sensitive to shrink and swell, the Copes Flowmatic is the correct answer. This steam-flow water-level control is the most rapidly accepted development of recent years. Direct or relay operated.

Sizes 1½" to 8", all pressure stds.

TO be most effective, your feed water regulators must be suited to the particular requirements of the boilers they serve. Boiler design, firing methods, operating procedures, load demands, and space limitations all require consideration.

Whatever your boiler plant characteristics, you will find a Copes Feed Water Regulator that is "made to order." For we manufacture simple level regulators and steam-flow water-level controls in several types, both direct operated and remote relay operated. In addition, every control valve is provided with plunger and ports designed for the existing pressures, temperatures, and rates of flow.

Thus a Copes assures you of individualized feed water control that is in complete agreement with the application. That's one reason why there are over 65,000 Copes Feed Water Regulators in service. For other sound reasons, write for General Catalog No. 12-41.

NORTHERN EQUIPMENT COMPANY

951 Grove Drive, Erie, Pennsylvania

FEED WATER REGULATORS • LIQUID LEVEL CONTROLS • PUMP GOVERNORS
DIFFERENTIAL VALVES • REDUCING VALVES AND DESUPERHEATERS

Branch Plants in Canada, England *Representatives Everywhere*

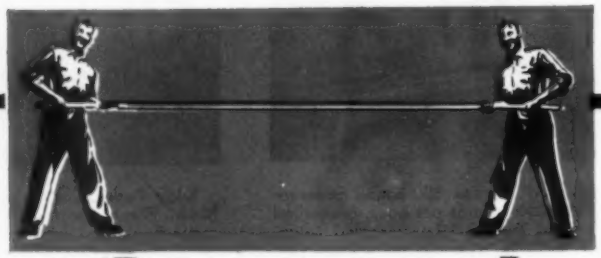
☆ *For* **SAFETY** *and* **ECONOMY** *Specify* COPES

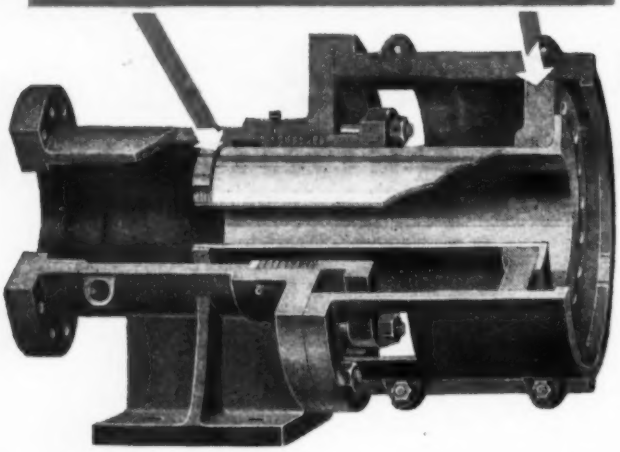
ADSCO

INTERNALLY-EXTERNALLY GUIDED

EXPANSION JOINTS

Keep the slip in perfect alignment because they are guided at BOTH ends





Slip Moves Through Packing Without Binding

Try to hold a pole at one end and keep it level. Then have someone hold the other end, and note the difference. That's precisely why the ADSCO Internally-Externally Guided Expansion Joint stays in alignment—why the slip moves through the packing space without undue pressure or distortion.

This protection against slip scoring is the reason why the intervals between repacking are few and far between when you use ADSCO Internally-Externally Guided Expansion Joints.

Install them on high or low pressure pipe lines, hot water, fuel oil, gasoline or process—wherever the most complete form of guiding is required. Write for Bulletin No. 35-20PR describing ADSCO Internally-Externally Guided Expansion Joints in sizes from ¼" up with 4" or longer traverses.

WRITE FOR YOUR COPY OF CATALOG DESCRIBING COMPLETE LINE OF ADSCO PRODUCTS

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA, NEW YORK

Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

Argument Corner

(*Continued from page* 126)

More on Boiler Blowdown

ACTUAL LOSS in Btu of water blown down from a boiler (Reader's Problems, March, 1945, POWER) is equal to the heat added to that water by the boiler. By means of flash tanks and heat exchangers most of this heat can be recovered. Boiler design and circulation permit only water to be discharged from blowoff lines.

Water flashed to steam, % =

$$\frac{H - B}{V} \times 100$$

Where

H = Heat of liquid at boiler pressure
B = Heat of liquid at flash pressure
V = Latent heat of evaporation at flash pressure

Amount of flash steam varies with the boiler pressure and flash pressure; temperature of the remaining water is the same as that corresponding to the flash pressure. To determine how much water remains after flashing, meter the runoff, weigh it or, knowing the amount of blowdown, subtract the percent flashed.

Cincinnati, Ohio W E RIXMAN

Vacuum Breaker On Exhaust

THE ANSWERS to "What Causes This Engine To Race?", published in June Reader's Problems, set me to thinking of a similar condition in the power plant where I first worked. This plant contained four 1600-hp triple-expansion marine engines, each direct connected to two Simemins-Halke 550-v dc generators.

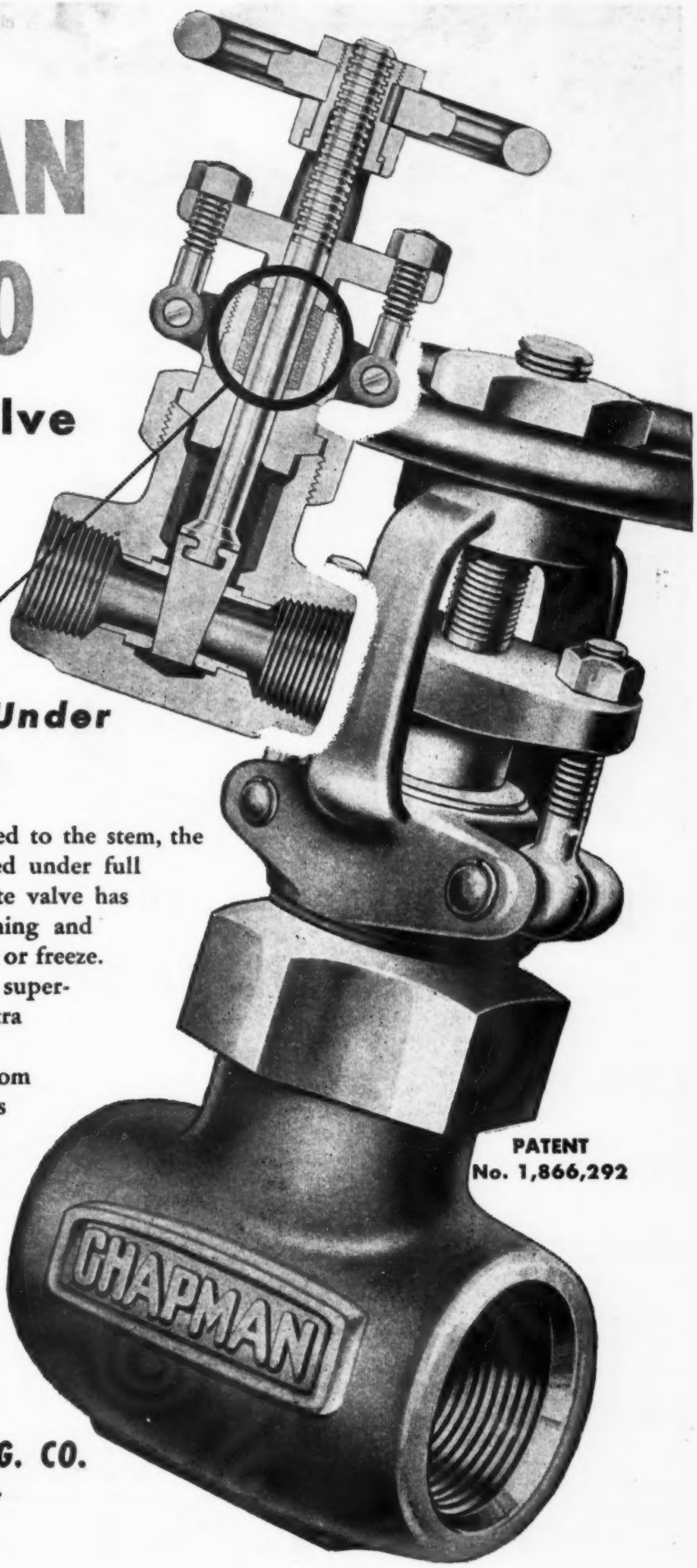
Each high-pressure cylinder was equipped with a piston valve controlled by a shaft governor. The i-p and l-p cylinders had balanced slide valves operating on constant cutoff. A plug cock on the exhaust pipe from the l-p cylinder to the condenser served as a vacuum breaker.

On starting up, this valve was left open until the load was thrown on the first generator. As the operator closed the switch he blew a whistle as a signal for the engineer to close the vacuum-breaker valve.

On light loads the engines governed badly, and without load would race when operated condensing. If the load was suddenly thrown off, the engines would race with the throttle valve

CHAPMAN List 960

Small Gate Valve



Can Be Repacked Under Full Pressure

Because no pressure is transmitted to the stem, the Chapman List 960 can be repacked under full pressure. This improved small gate valve has quick-acting threads for fast opening and closing—threads that will not stick or freeze. List 960 can also be furnished with super-hardened seats and plugs for extra severe services.

Chapman List 960 is made in sizes from ¼" to 2"—carbon steel for pressures to 800 pounds; alloy steel for pressures to 1000 pounds at 750°F. For higher pressures, specify List 990.

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The CHAPMAN VALVE MFG. CO.
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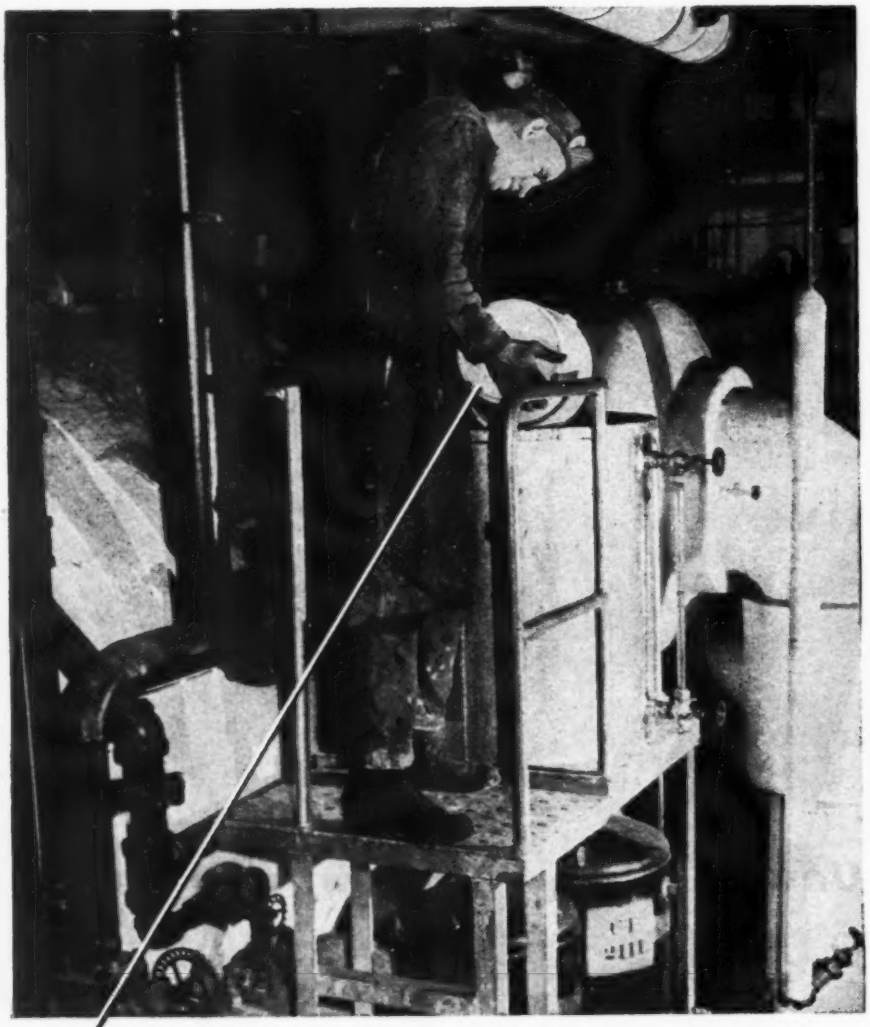

prevent oxygen corrosion this simple SANTOSITE WAY

Here's How You Do It: Positive protection against oxygen corrosion is just this easy: Maintain 30 parts of Santosite to one million parts of boiler water. Simple tests at regular intervals provide accurate checks.

Here's Why It Works: Santosite "eliminates" oxygen in boiler feed water by combining with it to form sodium sulfate (Na_2SO_4). Since sodium sulfate and Santosite are both water-soluble, no objectionable sludge is formed.

Here's What to Expect Santosite, a stable anhydrous crystalline product, is easy to handle, store and apply. Depending upon the oxygen content of the feed water, costs of continuous protection vary from $0.05 to $0.65 per million pounds of boiler feed. Santosite treatment means fewer shutdowns, less repairs, greater over-all efficiency.

For complete details on Santosite and its application to your system, write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second St., St. Louis 4, Missouri.
District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle, Montreal, Toronto.

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SERVING INDUSTRY...WHICH SERVES MANKIND

closed. When shutting down, the first operation was to open the vacuum breaker, and then close the throttle.

At the time I worked in this plant, I was too green both in experience and education to run down the fine points involved in the operation of marine engines as prime movers in power plants. However, the general opinion seemed to be as follows:

(1) The design of a marine engine, controlled by the high-pressure valve, is such that it is inferior to a corliss engine for widely varying loads.

(2) The marine engines are suitable only where the load is fairly steady, and well up towards full capacity.

H T LIVINGSTON
Los Angeles 27, Calif.

Oil-Pressure Starting

SINCE THE GENERATOR is to be used as a synchronous condenser (Reader's Problems, April, 1945 POWER) the machine is probably equipped with an ac voltmeter and ammeter, a dc field ammeter and a synchroscope. With these, safest way to start the condenser is with a belt and separate motor, preferably a wound-rotor type with secondary controller.

Condenser can probably be started at reduced voltage if a field discharge resistor of rather low resistance and ample wattage is provided to protect the field winding. This also requires a 2300-v starting compensator complete, or a set of interlocked oil circuit breakers and a 3-phase autotransformer.

If the condenser is a slow-speed machine with heavy field, starting can be facilitated by providing each bearing with a manually operated oil pump to lubricate the bearings just before starting; also, a diesel or aircraft engine starter might be geared to provide initial motion.

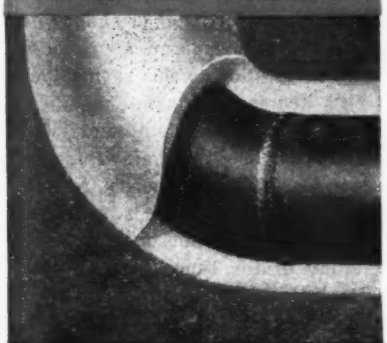
If the voltage regulator is provided with a current coil it can control condenser output in the following manner: Connect the regulator potential coil through a suitable transformer between phases *A* and *C* of the incoming line and install a current transformer in phase *B* where it will carry both the load and condenser currents. Connect it to the regulator current coil. With this connection the power component of current is out of phase with the potential, but leading or lagging component is in phase and causes a corresponding action on the potential coil.

Adjust the regulator to hold condenser voltage equal to, or slightly higher than, the line voltage at zero line load, and gradually cut the current coil in when the feeder is loaded. Check the

Photos courtesy Lincoln Electric Co.

ONCE DONE...

The larger the pipe, the greater the insulation saving contributed by streamlined Tube-Turn welding fittings.



Insulation fits smoothly because elbows and pipe form one continuous tube; no bolts to tighten, no gaskets to leak.

IT'S INSULATED FOR KEEPS!

In Cleveland's modern municipal power plant, the Tube-Turn welding fittings were as easily insulated as the pipe, because the welds form one continuous tube. There will be no future expense and trouble removing and replacing insulation every time bolts need drawing up or leaky gaskets need replacement. Once insulated, a system using Tube-Turn welding fittings is insulated for keeps!

Furthermore, welding the 10″ and 6″ steam lines shown here saved approximately 55% in joint costs over flange connections. Other benefits of Tube-Turn welding fittings include lighter weight, greater strength, and increased efficiency of flow. Because they require less space, they permit more flexibility of layout.

For complete information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for latest complete Catalog 111.

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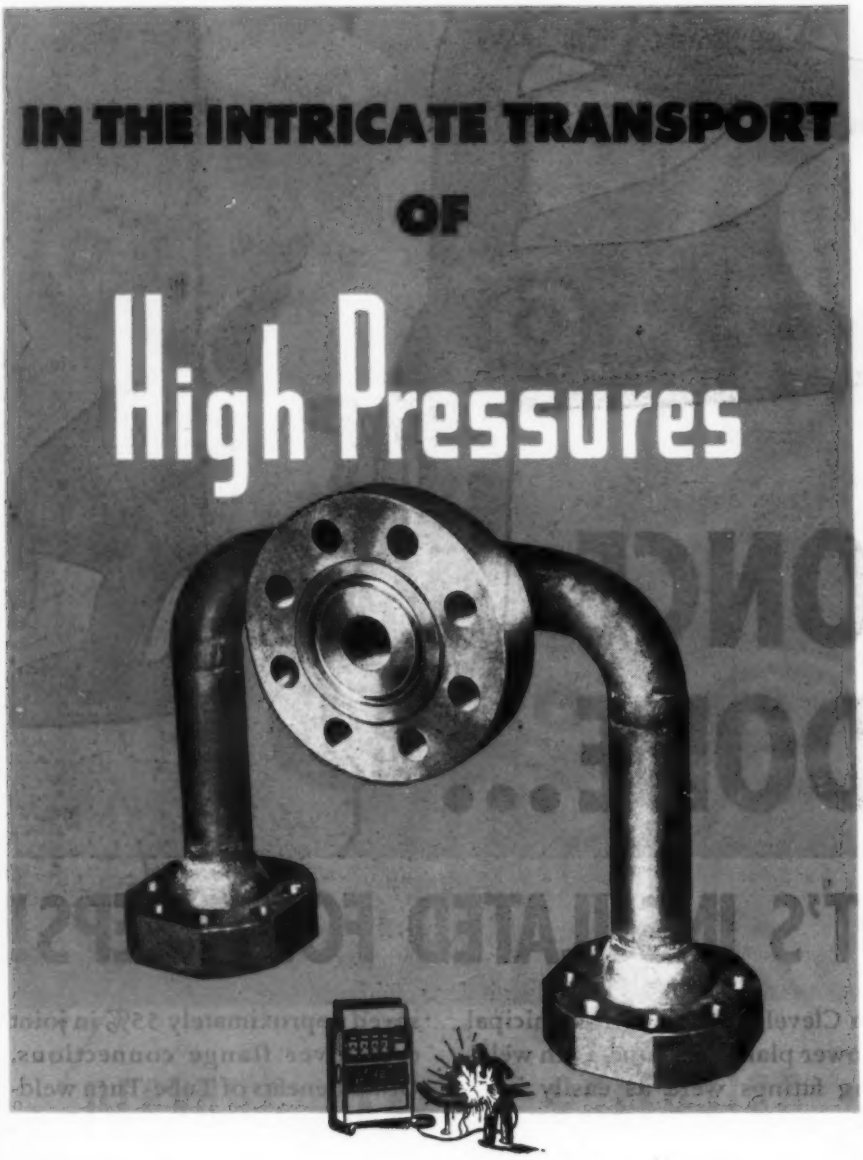

It would take some computing to evaluate the importance of fabricated piping used in the tricky business of transporting high pressures. Whatever its worth, science and industry find it essential to an ever greater degree.

Naturally ordinary methods and equipment are not sufficient to produce this type of work. Associated has designed and built exceptional equipment... not available elsewere...which amplifies a vast knowledge and high skill in the fabrication of high pressure piping. Look to Associated for progress in piping.

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polarity to make sure that a lagging feeder current causes the exciter voltage to rise. Also adjust the regulator stops so that exciter voltage cannot increase either the field or armature current beyond the machine rating, or fall to a point that makes condenser operation unstable.

Altoona, Pa. A R MARKLAND

Investment Pays Out in Three Years

TAKING THE NEW RATE of 9.5 lb of steam per lb of coal against 7.6 for the old boilers we arrive at a substantial saving (June Reader's Problems). Assume coal costs $6 ton. Take an average rate of 60,000 lb per hr for 24 hr and 300 days per year.

For the new boiler:

$\frac{60{,}000}{9.5}$ = 6,320 lb coal per hr

$\frac{\$6 \times 6320}{2000}$ = $18.95 per hr or 31.6¢ per 1000 lb steam

For the old boilers:

$\frac{60.000}{7.6}$ = 7,900 lb coal per hr

$\frac{\$6 \times 7900}{2000}$ = $23.70 per hr or 39.6¢ per 1000 lb steam

Fuel saving is $23.70 — $18.95 or $4.75 per hr. Then $4.75 x 24 hr x 300 days = $34,200 per yr. An approximate price for an 80,000-lb-per-hr unit is approximately $100,000.

Based on these figures the investment would pay for itself in about three years. This is considered an excellent return. In addition to this saving there will be a decrease in maintenance cost on the new boilers as compared to the old. This can be determined from a segregation of cost records for the past few years. For more accuracy estimate future repair costs.

A study of the types of coal available might result in greater fuel saving. The present settings and stokers no doubt limit to a great extent the kinds of coal that can be used. With installation of a new unit it might be possible to use a less expensive coal.

The boiler insurance company will be more critical of the condition of the old units as time goes on. The possibility of a forced reduction in pressure should be considered in relation to the generating or process equipment now installed.

Rahway, N. J. B J DI SANTO

Canvas Cover on Truck

I SUGGEST that *PRM* install, at a convenient point near the boiler plant, a bin large enough to take care of one

Nothing to get out of order in this

BRIGGS LUBE OIL CLARIFIER

Briggs Fullers Earth Cartridges clean straight mineral oil 3 times—3 ways, remove visible and invisible contaminants. Briggs Discel Cartridges remove dirt from additive-type oils without affecting the action of the additive. Both are interchangeable in all Briggs Clarifiers.

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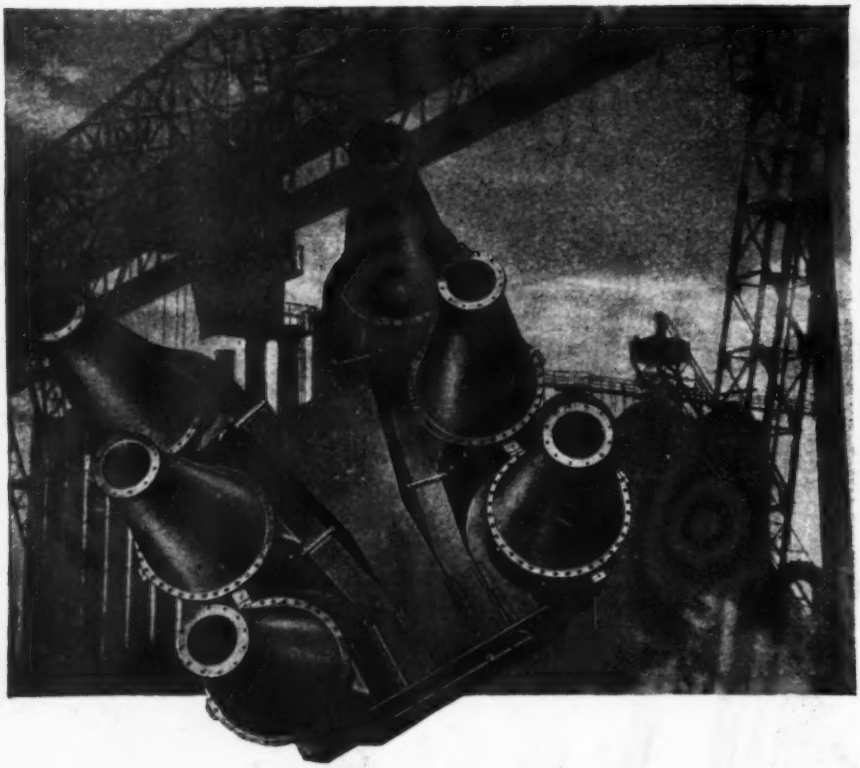

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SPLIT-DUCT MANIFOLDING used in Buell (van Tongeren) Multiple Cyclones ensures *uniform* distribution of *both gas* and *dust* to the cyclone collectors. This method is most important to final collection efficiency. Uneven distribution can cause local recirculation of gas, resulting in greater erosion rates in the cyclones receiving the higher concentrations and in the impairment of collection efficiency. With Split-Duct Manifolding, a Buell design feature, maximum collection efficiency is attained by this uniform distribution of the gas load.

The outlet can be installed to discharge the cleaned gases from *any side* or *end*, a flexibility of arrangement that cannot be obtained with *unit chamber manifolding*.

Buell Dust Recovery Systems are designed to do a job, not just to meet a "spec". A promise fulfilled by Buell's high efficiency, long life and low maintenance in hundreds of installations throughout American industry.

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DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

or two weeks' supply of flyash. Mount the bin 8 or 10 ft above ground level to dump the ash into the truck used to transport it outside the city limits.

Ash collectors could empty directly into the bin through metal chutes. Means could be provided to wet this flyash as it settled into the bin or as it emptied into the truck prior to its trip to the city dump. If the ash is transported dry it should be covered with canvas.

Pumping to a dump offers advantages if the ash is covered so as not to fly over surrounding areas when it dries. If it is trucked to a city dump other rubbish will soon offer a protective cover against the wind.

Philadelphia, Pa. W T MULLEN

New Boiler Offers Economies

IT SEEMS TO ME that HC (June Reader's Problems) has the answer to his problem right in his plant, and should be in a position to convince any forward-looking business man of the soundness of his argument.

I should say that the present units have outlived their economic usefulness in 20 years when compared with modern watertube boilers.

Using HC's figures and assuming a normal 10-hr day, at 60,000 lb per hr, the new boiler requires about 60,000 lb, or 30 tons of coal per day. The old boilers at the same rate of steam production require 40 tons of coal per day. Coal delivered at $7 per ton means a daily fuel cost of $280 as compared to $210—a saving of $70 per day. On a 5-day week it means $350, and for a 52-week year a total of $18,200. A saving of about $20,000 per year is not to be overlooked. I am sure it will look good to the boss.

There are other economies. For instance, in the matter of coal handling: *by the week*, only 150 tons of coal compared to 200 tons, and, delivered in 50-ton cars, three cars instead of four; *on a yearly basis*, 7800 tons compared to 10,400 tons, and handling 136 cars in place of 204.

Bogota, N. J. E C GRIEF

Reader's Problems

(*Continued from page* 117)

The latter discharges through a swinging gate into the ash-storage tank.

The motor-driven blower exhausts air from the ash receiver, which causes

Wire ahead

Don't handicap tomorrow's equipment with yesterday's wiring.

IT'S A FACT that inadequate wiring can reduce equipment performance by twenty-five to fifty per cent. This is true right now—and think of your greatly expanded electrical future!

Remember, wiring comes *first!* Foresighted wiring based on future needs—not tied to formulas of the past.

It costs nothing to review your wiring plans now. But it may cost plenty for shutdowns, teardowns to permit extensive alterations later.

Make a note of it: Check wiring plans! Call in your consulting or plant power engineer—electrical contractor or power salesman. Let them help match your wiring to future production hopes. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company. General Offices: 25 Broadway, New York City 4. Chicago Office: 20 North Wacker Drive 6. Sales Offices in Principal Cities.

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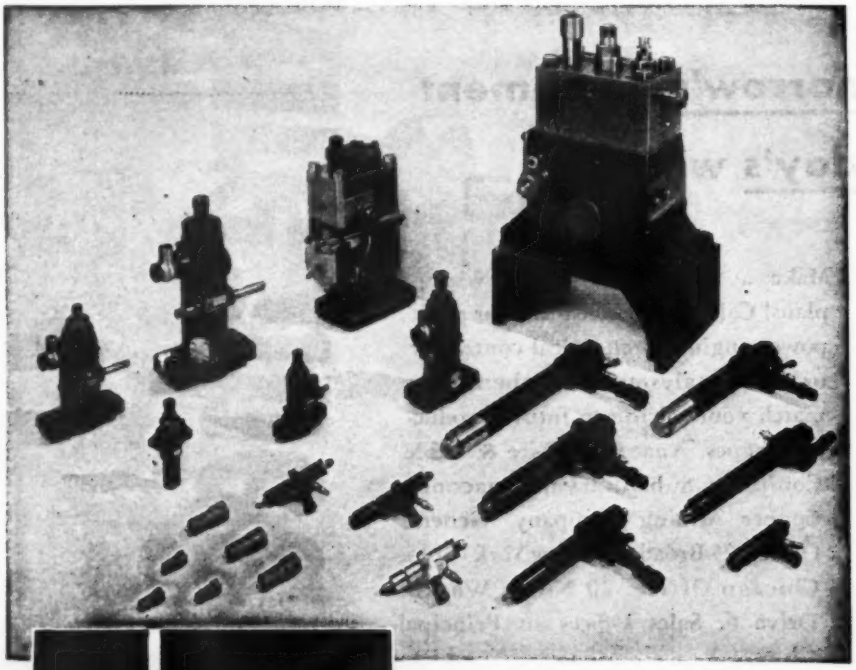
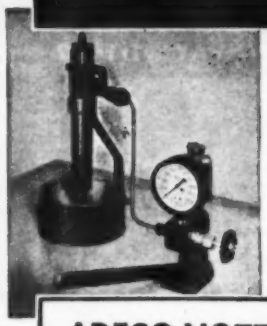


adeco..

YOUR SOURCE FOR DEPENDABLE FUEL INJECTION EQUIPMENT



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America's most widely used nozzle tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressures up to 10,000 p.s.i. Tests both large and small injectors on bench or engine. Prevents costly delays and possible damage to engine. Standard or Navy-approved gauge. Ideal for testing hydraulic equipment. Write for bulletin.

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the swinging gate to close. Thus a high-velocity flow of air through the conveying pipes is created. The operator then opens the ash-hopper gate allowing ashes to drop into the conveyor intake from where they are carried along by air.

Ashes enter the circular receiver at a tangent, which produces a swirling action. Thus they separate from the air and drop to the receiver bottom. At intervals an air-release timer opens a relief valve. This shuts off suction on the receiver and the swinging gate opens to discharge ash to the storage tank below. Then the timer closes the relief valve and the cycle repeats. Transporting air discharges out the top of receiver and passes through an air washer before entering the exhauster.

With some methods of firing, considerable flyash is collected in boiler passes, (2-A, p 117) economizer, air preheater and boiler breeching. These parts are usually quite remote from each other making a manually operated ash-removal system inconvenient. One fully automatic method utilizes the vacuum produced by high-pressure water jets. Connection between the conveying pipe and ash hoppers is through electrically operated rotary valves.

After the ejector is started and vacuum established, the operator presses a button to open one ash valve. When that hopper becomes empty vacuum gage reading drops sharply; the operator then closes the valve and opens another until all hoppers have been cleaned. Water from the jets sluices the ash to a disposal point.

When flyash contains a high percentage of unburned carbon a steam- or air-ejector system can be installed to return it to the furnace, sketch 2-A.

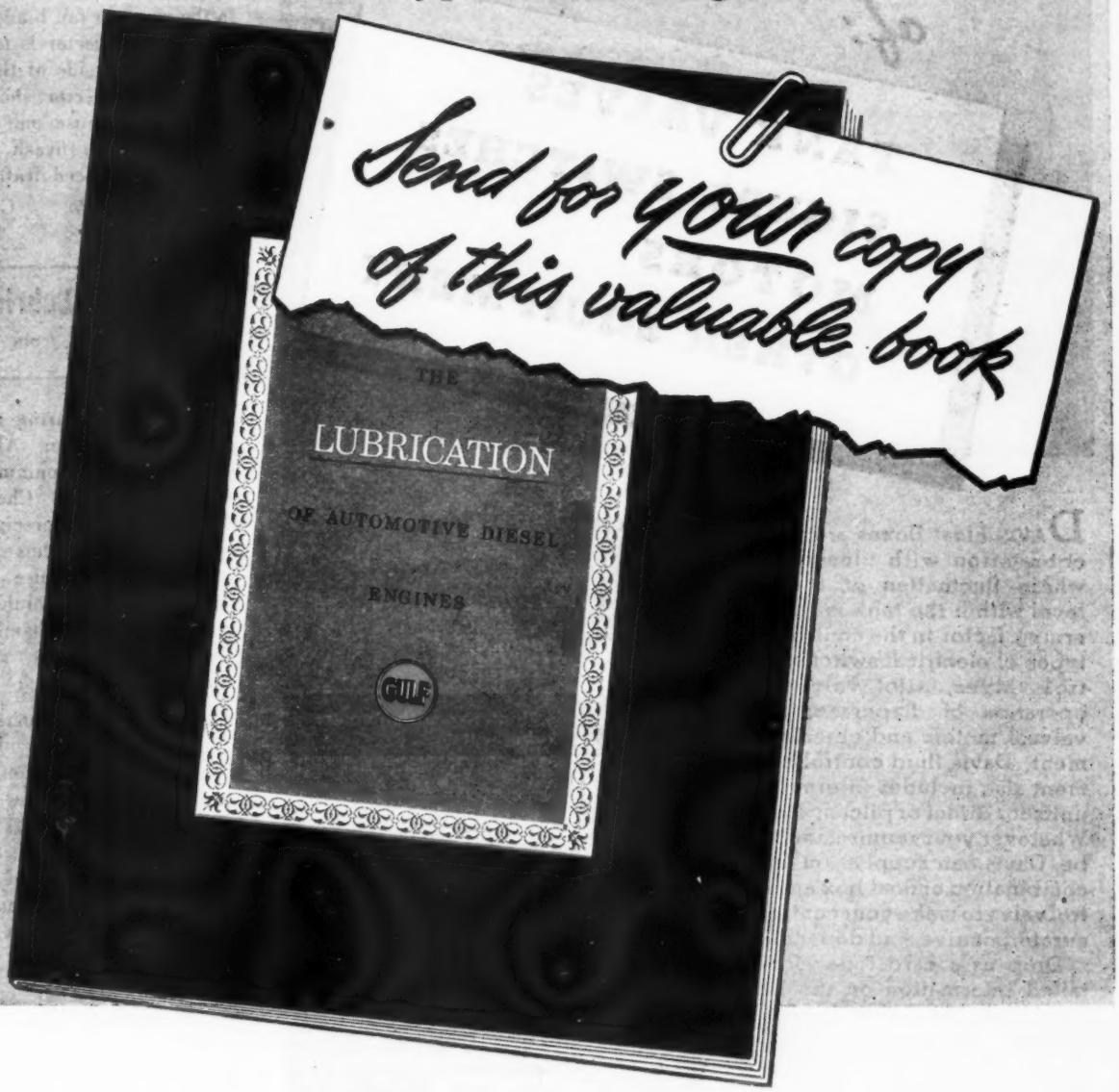
San Francisco, Calif. O T SMITH

Locate Collector Ahead of Draft Fan

SIMPLEST WAY to dispose of flyash is to connect the collector to some point in the main ash-disposal system. If stoker hopper dumps directly into a larry car or truck, or if the ashes from this hopper are elevated to an overhead bin, flyash from the collector can be piped to the ash hopper. If the ashes are removed by hydraulic or pneumatic systems, discharge from the collector can be introduced into the ash hopper or into the conveyor system at any convenient point. All connections between collector and ash hopper or ash-disposal system would, of course, be outside the boiler.

With such a system I cannot see how

Memo to operators of Automotive-type Diesel engines:



48 pages of useful information!

READ the new Gulf book "The Lubrication of Automotive Diesel Engines"! Here are some of the important subjects covered in this instructive book: Selection and care of lubricating oil, functions of the lubricating oil, engine tests, Diesel fuels and their combustion—and many others.

It tells how to break in new rings faster, when to replace pistons, the nature of light-load and low-temperature engine troubles, and answers many other important operating questions.

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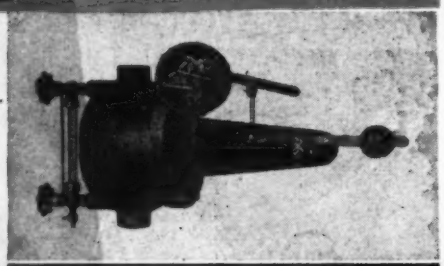

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Davis No. 162D Packless Float Box with Pilot Valve and No. 14 Diaphragm Motor Valve.

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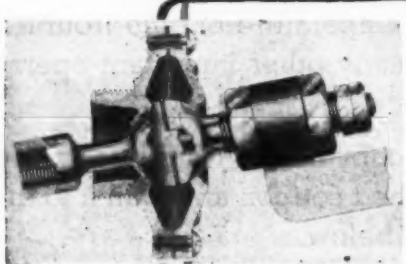

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there would be any flyash recirculation, whereas flyash discharged to the stoker hoppers would accumulate and recirculate.

The statement that recirculation adds to the wear on fan blades indicates that the flyash collector is to be located on the discharge side of the induced-draft fan. The collector should be on the inlet side because one of the benefits derived from a flyash collector is reduction in induced-draft-fan wear.

Pittsburgh, Pa. C J WYROUGH

Diesel Lubrication

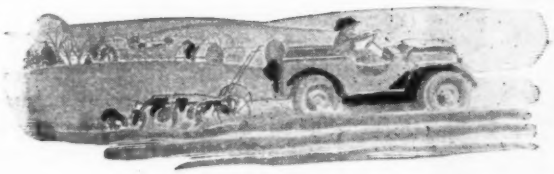
(*Continued from page* 71)

attack certain bearing metals, causing pitting and failure. Also, these acids react with the remaining parts of the oil to form sludges. Chemically, sludge may be defined as precipitated oxidized hydrocarbons. It thus differs from the organic acids because it is insoluble and the acids are soluble. Sludge deposits in the valve chambers, sumps, on filters and strainers, and in the oil cooler.

Acid-reaction products formed in lubricating oil are also blamed by some for varnish deposits on pistons, valve stems and other metal parts. These hard, black films occur when oxidation products, soluble in oil up to a certain point, deposit on heated metal surfaces. On valve stems varnish may cause sticking or burning, and on pistons it promotes ring sticking.

These lubrication problems result from changes that take place in the oil itself as a result of exposure to heat and air. Contamination from outside sources contributes to these problems and adds new ones. Starting again in the combustion space, we find that products of combustion mix with the lube oil; these include ash, carbon particles or soot, unburned "heavy ends" of the fuel, and water. Ash, carbon and soot help to build up the deposits that cause ring sticking. Unburned fuel may be cracked or oxidized in the high-temperature zone near the rings, making a resinous, gummy material that forms a binder for soot or carbon particles and thus contributes to ring sticking.

Unburned fuel that finds its way past the rings and into the crankcase dilutes the lubricating oil, tending to make it thinner and less able to form a good film. For every gallon of fuel burned, about a gallon of water forms as a combustion product. This normally



WHEN your equipment calls for small horsepower, you're saving money when a Coppus "Blue Ribbon" Steam Turbine is on the job.

Coppus makes turbines in six frame sizes from 150 HP down to fractional — so you can "fit" the power more closely to the need. No reason to pay extra for ordinary "elephant power" turbines, when you have a small horsepower requirement.

Many well-known manufacturers of original equipment have selected Coppus turbines. And they are to be found on U. S. destroyer escorts, driving vertical lubricating oil pumps . . . on U. S. Casablanca class aircraft carriers, driving main and auxiliary circulating pumps and fire pumps . . . on more than 90% of all Landing Ship Docks, driving condensate and clean ballast pumps.

A job for a Jeep, not a Truck

You, too, can rely on their dependable performance to meet your requirements for "jeep" power. Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), the Coppus turbine is a precision-made product — its accuracy controlled by Johansson size blocks — and every turbine is dynamometer-tested before shipment. Since 1937, more than 85% of orders have been repeat orders. Write for Bulletin 135-10. COPPUS ENGINEERING CORPORATION, 169 Park Avenue, Worcester, Mass. Sales Offices in THOMAS' REGISTER. Other products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

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THE COMPRESSOR PEOPLE

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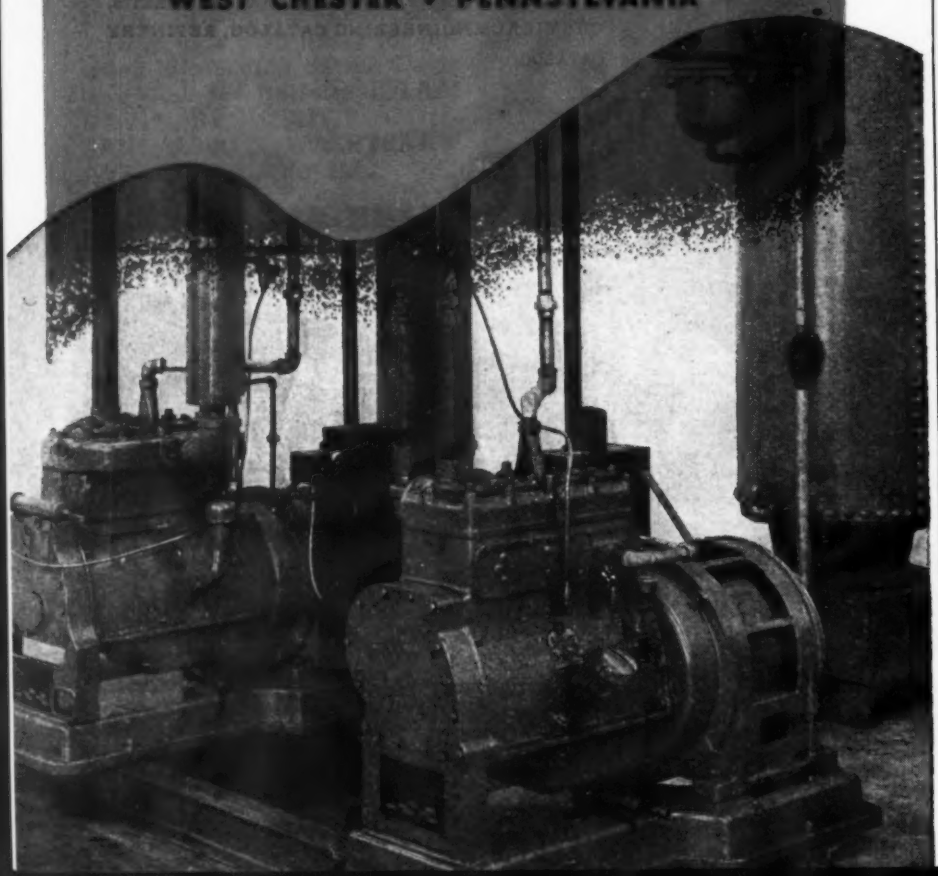


passes out the exhaust as vapor, but low jacket-water temperature may cause some of it to condense, particularly on the lower parts of the cylinder liner. This prevents proper wetting of the liner with oil and, if hydrogen sulphide or sulphur dioxide are present to form acids, serious corrosion may result. Some authorities believe such condensation is a major cause of excessive liner wear.

Water that reaches the crankcase oil may cause formation of mayonnaise-like emulsions, which accumulate over screens and in the circulatory system, blocking flow. As water also tends to increase the activity of organic acids in oil it may accelerate corrosion of bearings and other crankcase parts.

The engine itself may form another source of lubricating-oil contamination. Metallic oxides, which accumulate in a lubricant during service, act as powerful catalysts and hasten the oil's deterioration even though present in amounts as small as fractions of 1%. Iron oxide may come from a leaky jacket or cylinder liner, copper or aluminum oxide from the circulatory system or from heated engine parts.

Dust Contamination

Dirt and dust may enter the cylinders through the air-intake system, particularly if filters are in poor shape, and may enter the crankcase through the breather if it is not protected. Under operating conditions, the oil film on the cylinder walls is of microscopic thickness and thus even the smallest particles of dust have a deadly abrasive action. Further contamination may result from small metal particles from engine wearing surfaces.

The foregoing outlines in somewhat simplified form the basic problems of diesel lubrication. What can be done about them? For one thing, refiners are producing ever better lubricants. These oils are refined to have suitable physical characteristics and, even more important, desired chemical characteristics. Considerable research has been carried out to increase the resistance of oils to oxidation, in other words, to make them stable. This has been accomplished to some extent by improved refining and also by adding oxidation inhibitors. Still other additive compounds may be used to produce so-called detergent oils, that is, oils which tend to keep the oxidation products dispersed and suspended to avoid harmful deposits.

The operator plays his part by maintaining engines and accessory equipment in good mechanical condition, thus reducing contamination by blowby,

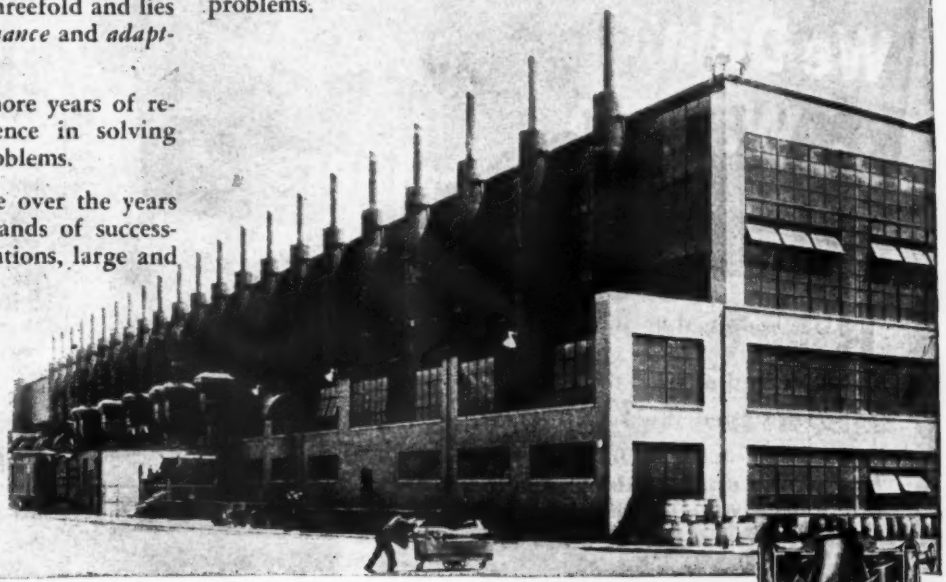
WHY DO YOU FIND MAXIMS on the really TOUGH silencing jobs?

The giant Maxims standing out against the skyline below quiet the exhaust of Diesels on test stands at a large industrial Diesel manufacturing plant. Time and again in important installations of this kind and in many smaller installations where the silencing problem is none the less critical, the most satisfactory answer has been found with Maxims.

The reason "why" is threefold and lies in *experience, performance* and *adaptability.*

- Maxim can show more years of research and experience in solving tough silencing problems.
- Maxim performance over the years is typified in thousands of successful working installations, large and small.
- Maxim adaptability means a line of silencers so varied that it is seldom necessary to go beyond the standard silencers to get a job "tailor-made" for your installation.

By the same token when special silencers *are* needed, Maxim engineers, constantly working on development and new design problems, are particularly capable of solving your special problems.



These Maxim Silencers (model MUC illustrated) are designed to silence the exhaust or intake of internal combustion engines, steam engine exhaust, air compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements. Spark arresting where necessary.

Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the efficient recovery of waste exhaust heat to produce steam or hot water for heating or processing operations. These Heat Recovery Silencers give highly efficient heat transfer . . . are available with automatic controls, and may be run wet or dry without injury to the unit.

THE MAXIM SILENCER CO. • 92 HOMESTEAD AVE., HARTFORD, CONN.

ARMY E NAVY

MAXIM

We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion—*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt—lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY
100 MERMAID AVE. PHILADELPHIA 18, PA.

YARWAY STRAINERS

condensation and foreign matter. Finally, he can, by adopting a sound program of lubricating-oil purification, eliminate the unavoidable decomposition and contamination products, maintaining the oil at or near its original state of effectiveness.

Knowing the fundamentals outlined here, the operator can study with profit the many excellent detailed discussions on diesel lubrication problems recently published, and from them work out a program of oil selection, oil purification and engine operation that meets the needs of his plant.

Dr Durand and Others Receive ASME Awards

Dr William Frederick Durand, chairman of the division of engineering and industry of the National Research Council, Washington, has won the American Society of Mechanical Engineers Medal, the society's highest honor, in recognition of his work in hydrodynamic and aerodynamic science, particularly the forwarding of design and application of principles of jet propulsion, and of his services to the Government in engineering research.

Holley Medal of the society will go to Dr Sanford Alexander Moss, General Electric engineer, West Lynn, Mass., for his pioneer work in turbo-superchargers, which largely made possible the height, speed and range of modern aircraft.

Melville Prize Medal of the society will go to William Julian King, research engineer with the fuels div of Battelle Memorial Institute, Columbus, Ohio, for his paper, *The Unwritten Laws of Engineering.*

Bruce E Del Mar, supercharging engineer with the Douglas Aircraft Co, Santa Monica, Calif., will receive the Junior Award for his paper, *Presentation of Centrifugal Compressor Performance in Terms of Non-Dimensional Relationships.*

Honorary memberships in the society include Rear Admiral Harold Gardiner Bowen, USN, Naval Research Laboratory, Anacostia Station, Washington, for scientific service to his country; Dr Dugal Caleb Jackson of Cambridge, Mass., professor emeritus, Massachusetts Institute of Technology, for leadership in education and consulting engineering fields; and Dr Andry Abraham Potter, acting president, Purdue University, West Lafayette, Ind., for leadership in adjusting engineering education to the needs of war training.

Formal presentation of the awards and honors will be made late in November.

Senator William Langer, North Dakota Republican, introduced a bill approving the U. S.-Canadian agreement under which the St. Lawrence seaway and power project would be authorized for construction. The bill provides that power facilities be turned over to the New York State Power Authority, which would pay the government $93,375,000 over a period of 50 years, with interest at 3%.

What qualities to look for in cost-saving greases

QUALITIES that reduce wear on bearings and gears . . . that stop excessive consumption . . . that cut oiler time for servicing equipment . . . these are the qualities you want in a grease. What they are and how you can get them is described in a booklet illustrated at right.

Many of the advantages, which you would expect to find only in special purpose, premium priced greases, are available in a line of 11 grades—including high-temperature greases—called

SUPERLA GREASES

Send for this Booklet

It tells how the most desirable qualities have been incorporated in a complete line of grease to reduce costs on a wide range of Industrial application.

It also has hints on hand packing anti-friction bearings and avoiding over-lubrication.

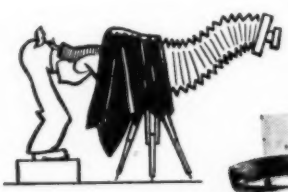
You can get a copy from the Standard Oil Industrial Service Representative who calls on you or by writing Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

Buy more War Bonds

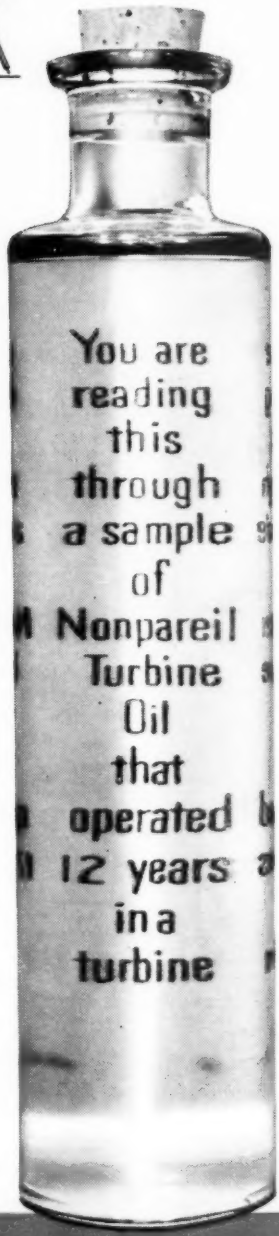
STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

There is a message for you in this turbine oil sample



A life-size unretouched photograph



Of course, the picture doesn't tell the whole story, so here are the facts.

The sample illustrated is from a fill of oil installed in a 5000 kw. turbine, June, 1933. Since then, the turbine has operated regularly, yet this fill of oil—

- has never been removed from the turbine oil system for treating or resting.
- has only been filtered through a bag-type filter.
- has shown no sign of rust or corrosion.
- has Tag-Robinson color of 16.
- has the extremely low neutralization number of .04 mg. KOH/gm.
- has an indefinite period of the same clean, acid-free operation ahead—it is guaranteed for the life of the turbine.

Compare this record with the time, trouble and expense of maintaining a fill of oil for 12 years in your plant. Compare also the years of guaranteed satisfaction still available in this fill of Nonpareil Turbine Oil. Wouldn't it pay you to change to Nonpareil Turbine Oil now?

A Standard Oil Lubrication Engineer will be glad to answer any questions you have about Nonpareil Turbine Oil. Call the local Standard Oil Company (Indiana) office, or write 910 South Michigan Avenue, Chicago 80, Illinois.

Buy more War Bonds

NONPAREIL
TURBINE OIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★LUBRICATION ENGINEERING

. . . AND DO YOU KNOW YOUR VALVES?

IF you are an engineer, a purchasing agent, or a maintenance man, you rightfully pride yourself on your familiarity with the tools and equipment of your business.

ALL RIGHT, HOW ABOUT VALVES?

Quizzes and observation tests are so popular nowadays that we've worked out this one for you on the famous Darling Fully Revolving Double Disc Parallel Seat Valve.

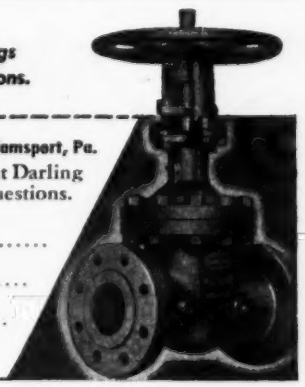
Here's what to do—Study the above picture for one minute, concentrating on every detail. Then cover up the picture and ask yourself the 11 questions in the box at the right.

If you don't know the answers — when you look at the picture again — then you've a special invitation to get better acquainted with the Darling Fully Revolving Double Disc Parallel Seat Gate Valve. Just clip and send in the coupon below and get the answers.

TEST YOURSELF WITH THESE QUESTIONS?

1. *Is this a gate valve or a globe valve?*
2. *Is this valve open or closed?*
3. *How many parts make up the gate?*
4. *Are discs and wedges bolted together?*
5. *What is the function of the two discs?*
6. *What is the advantage in having discs fully revolving?*
7. *Are there two wedges? Why?*
8. *What does "wedging action" do when gate is lowered?*
9. *Can parts be assembled incorrectly?*
10. *Where are pockets to collect sediment?*
11. *Service and long life considered, isn't this Darling Valve the best one you could buy?*

The coupon below brings the answer to the questions.



DARLING VALVE & MANUFACTURING CO.

WILLIAMSPORT, PA.

Darling Valve & Mfg. Co., Dept.E-11, Williamsport, Pa.

Gentlemen: I want to know more about Darling Valves. Send the answers to the 11 questions.

Name .....

Company .....

Address .....

City ..... State .....

Air Express gets New Truck in Production weeks Faster

When the Army orders new equipment — a truck, for instance — things move at break-neck speed. Blueprints, specifications and material specimens shuttle back and forth. Then come tools, jigs, dies. And it's mostly done at 3-mile-a-minute speed via Air Express.

Getting peacetime civilian products to market will also have the same kind of urgency. There's not only competition to meet but payrolls and overhead, too. Air Express is a money-saver because it's a time-saver. It is one of the most versatile of all industrial tools. It will pay you to investigate its use and economy in your business — whatever business you're in.

Specify Air Express-a Good Business Buy

Shipments travel at a speed of three miles a minute between principal U. S. towns and cities, with cost including special pick-up and delivery. Same-day delivery between many airport towns and cities. Rapid air-rail service to 23,000 off-airline points in the United States. Direct service to scores of foreign countries.

AIR MILES	2 lbs.	5 lbs.	10 lbs.	25 lbs.
250	$1.04	$1.25	$1.57	$2.63
500	$1.11	$1.52	$2.19	$4.38
1000	$1.26	$2.19	$3.74	$8.75
2500	$1.68	$4.20	$8.40	$21.00

AIR EXPRESS

GETS THERE FIRST

Write Today for interesting "Map of Post-war Town" picturing advantages of Air Express to community, business and industry. Air Express Division, Railway Express Agency, 230 Park Avenue, New York 17. Or ask for it at any Airline or Express office.

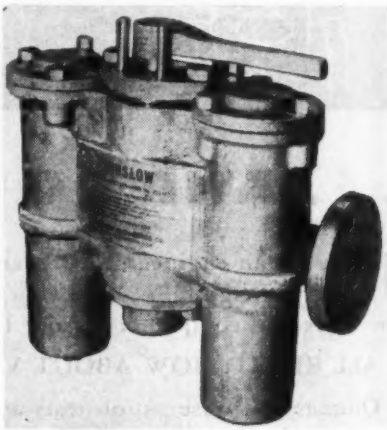
Phone AIR EXPRESS DIVISION, RAILWAY EXPRESS AGENCY
Representing the AIRLINES of the United States

New Equipment

(*Continued from page* 130)

ternal and internal cooling fins, exchanger features a multiple-action helicoid flighting. Velocity of the element (air or gas) under pressure revolves helicoid flighting at high speeds forcing air or gas outward against internal cooling fins. These internal cooling fins absorb the heat rapidly, or Btu's generated in compression, and dissipate this heat to outside atmosphere through external cooling fins—thereby lowering the element to room temperature in length of unit. By this cooling action vaporized moisture and oil suspended in the element condenses and is entrained in the sump, assuring a moisture-free, cooled element at discharge point.

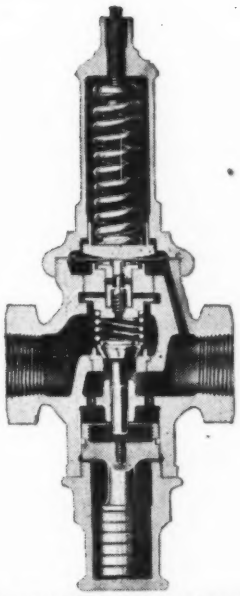
Parallel assemblies of the exchanger may be made for accommodating large volumes of air or gas. Another advantage in design permits tandem installation to any required length. Temperature exchangers are available for both flanged and screwed assemblies and also may be provided for either manual or automatic draining of sump. **Bird-White Co, 3119 W Lake St, Chicago 12, Ill.**



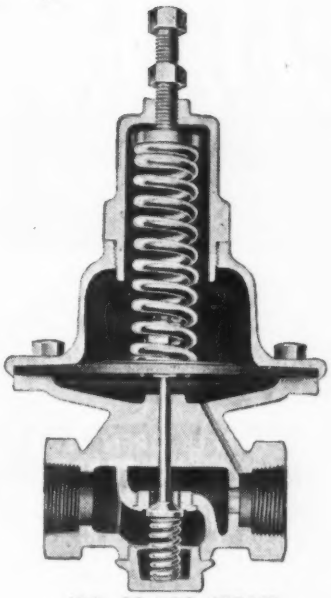
Magnetic Strainer

IMPROVED STRAINER combines effect of powerful permanent magnets with fine screening to remove filings and metal particles from oil systems or other liquids. Two cylindrical baskets consist of a main body of perforated steel, within which are fine-wire-mesh linings. The magnets are suspended within these baskets. Of either cast bronze or iron, the one-piece body incorporates the manifold, strainers, inlet and outlet connections, bypass valves, pressure regulator and main control valve.

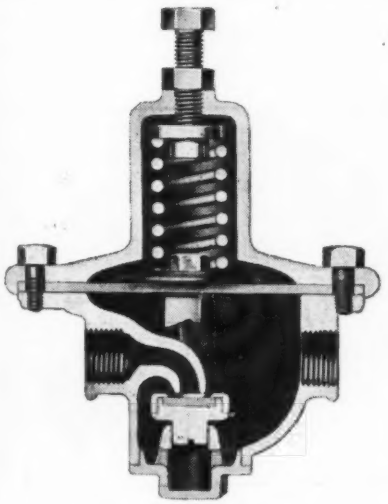
Quick-acting hand-operated 3-way control valve, simplified so as to require no jacks to lock it in place, permits change of flow from one strainer element to the other, or through both simultaneously. Flow is maintained through either one or both strainers regardless of position of valve control lever. With flow directed through one basket, the other basket-and-magnet assembly can be removed for cleaning as one unit. If necessary, magnet assembly can be detached



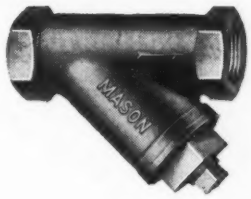
NO. 11 FOR STEAM SERVICE



NO. 33 FOR STEAM



NO. 227 FOR WATER



USE A MASONEILAN STRAINER

in all water, steam or air lines to protect valves, traps, etc., from scale, dirt or other foreign matter. These strainers are precision-built for long reliable service. They cost no more than others. Sizes ¼", 1½".

MASONEILAN REGULATORS PROVIDE BIG SAVINGS

Through Accurate Performance, Less Maintenance and Long Life

Noteworthy among the many performance advantages of Masoneilan Pressure Regulators are that they *reduce waste* by holding pressures where you want them . . . cut maintenance to the bone because of their rugged construction and simplicity of operation . . . reduce production delays by minimizing time-out for servicing. Masoneilan Pressure Regulators are available for steam, air and water reducing service.

Catalog 73 gives complete information on these and other types of regulators. Write for copy.

MASON-NEILAN REGULATOR COMPANY

1183 ADAMS STREET, BOSTON 24, MASS., U.S.A.

New York Chicago St. Louis Philadelphia Houston
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Mason Regulator Co. of Canada, Ltd., Montreal, Canada

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MASONEILAN

CORRECT DRAINAGE
at all operating pressures

The Stickle Open Float Trap is available in design to meet specific operating conditions and in capacity for handling required volume under given conditions.

STICKLE SERIES 100

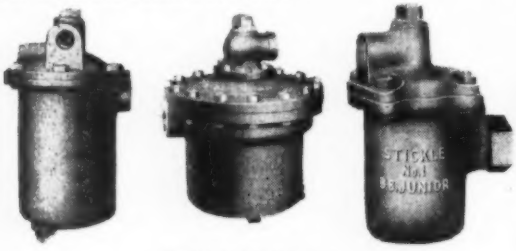
A series of traps with a capacity range of 250 to 4,500 lbs. per hour for drainage of smaller units operating at low, medium and high pressures. Built for straight-in-line installation. See Bulletin No. 115.

STICKLE SERIES AE

A series of traps with a capacity range of 4,500 to 18,000 lbs. per hour for drainage of larger units operating at medium and high pressures. Multiplies old standard capacities by four. See Bulletin No. 31's.

STICKLE SERIES 50

This series of Stickle Traps especially designed for drainage of processing units operating at medium to high pressures creating unusually large volumes of condensate. Capacity standard 8 to 10 times that of standard traps. Capacity range 18,000 to 45,000 lbs. per hour. See Bulletin No. 515.



STICKLE SERIES T

A series of traps for drainage of units working at medium and low pressures and to work with vacuum systems. 12 styles and sizes afford a wide range of adaptations and meet a wide range of requirements. See Bulletin No. 415.

BULLETINS FOR SPECIFICATIONS AND DATA

For complete data and specifications ask for bulletins mentioned above. Mailed on request.

STICKLE OPEN FLOAT STEAM TRAPS

The Stickle Open Float principle of construction is adapted for drainage of equipment operating at high pressures, medium pressures, low pressures or with vacuum systems. Stickle Open Float is both simple and positive, supplying a natural operation that is thoroughly efficient and completely effective.

NO MECHANICAL DIFFICULTIES

The Stickle Open Float avoids complicated construction. Stickle traps open and discharge when the Open Float loses buoyance and opens valve; they close when the Open Float regains buoyance and closes valve. Both actions are instantaneous. The movement, up or down, is slight. There is no friction, no sticking. There are no levers or hinges—no unnecessary mechanical parts. Air and gases are discharged with condensate.

EFFICIENT DRAINAGE—LONG SERVICE LIFE

The installation of Stickle Steam Traps means complete drainage efficiency—and dependable service with long life. Stickle Traps supply better drainage. Better drainage improves production and reduces costs.

OTHER STICKLE EQUIPMENT

Stickle Regulating and Reducing Valves
Ask for Bulletins Nos. 235 and 435

Stickle Differential Drainage and Boiler Return System
Ask for Bulletin No. 250

Stickle Triplex Oil and Steam Separators
Ask for Bulletin No. 200

Stickle Open Coil Feed Water Heaters and Purifiers
Ask for Bulletin No. 117

Stickle

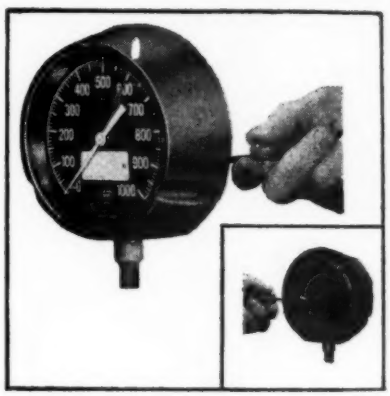
STEAM SPECIALTIES COMPANY
2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

from basket for additional cleaning or inspection. Outgoing pressure may be regulated by a valve adjacent to 3-way valve.

Developed originally for steam-turbine power plants, the Model 200-MS-1 Winslow *Duplex* strainer handles 15 gpm. Also available is a larger model handling 40 gpm. Where finer filtration of liquids is necessary, Winslow cartridge conditioners may serve with strainer. In addition to turbine-generator field, there are other applications, such as filter oil used in large speed-reducing or speed-increasing gears; on run-in test stands for gasoline, diesel or steam power units to remove filings and metal cuttings during initial tests. **Winslow Engrg Co, Oakland, Calif.**

Exterior Coating

A SIMPLIFIED AND IMPROVED METHOD of coating exterior masonry surfaces, *Mason-Cote* goes over damp brick, concrete, cement, stucco, cinder block, etc. It has exceptional adhesion, according to maker, and is unaffected by temperature extremes. Coating weathers white because it is selfcleaning. Although an oil paint, it is resistant to lime action. **Wilbur & Williams Paint Corp, Park Square Bldg, Boston, Mass.**



Gage-Pointer Adjuster

CERTIFIED PRESSURE GAGES are now equipped with *Hairline* pointer adjusters. With this new device, pointers can be reset quickly and easily without removing glass or ring. This is convenient when testing gages on test pumps and dead-weight testers. Slotted adjusting screw in back of case changes relative position of roller and cam of *Helicoid* movement, thus changing position of pointer. Fine adjustment is obtained by slight turn of screw. **Certified Guage & Instrument Corp, Long Island City 1, N. Y.**

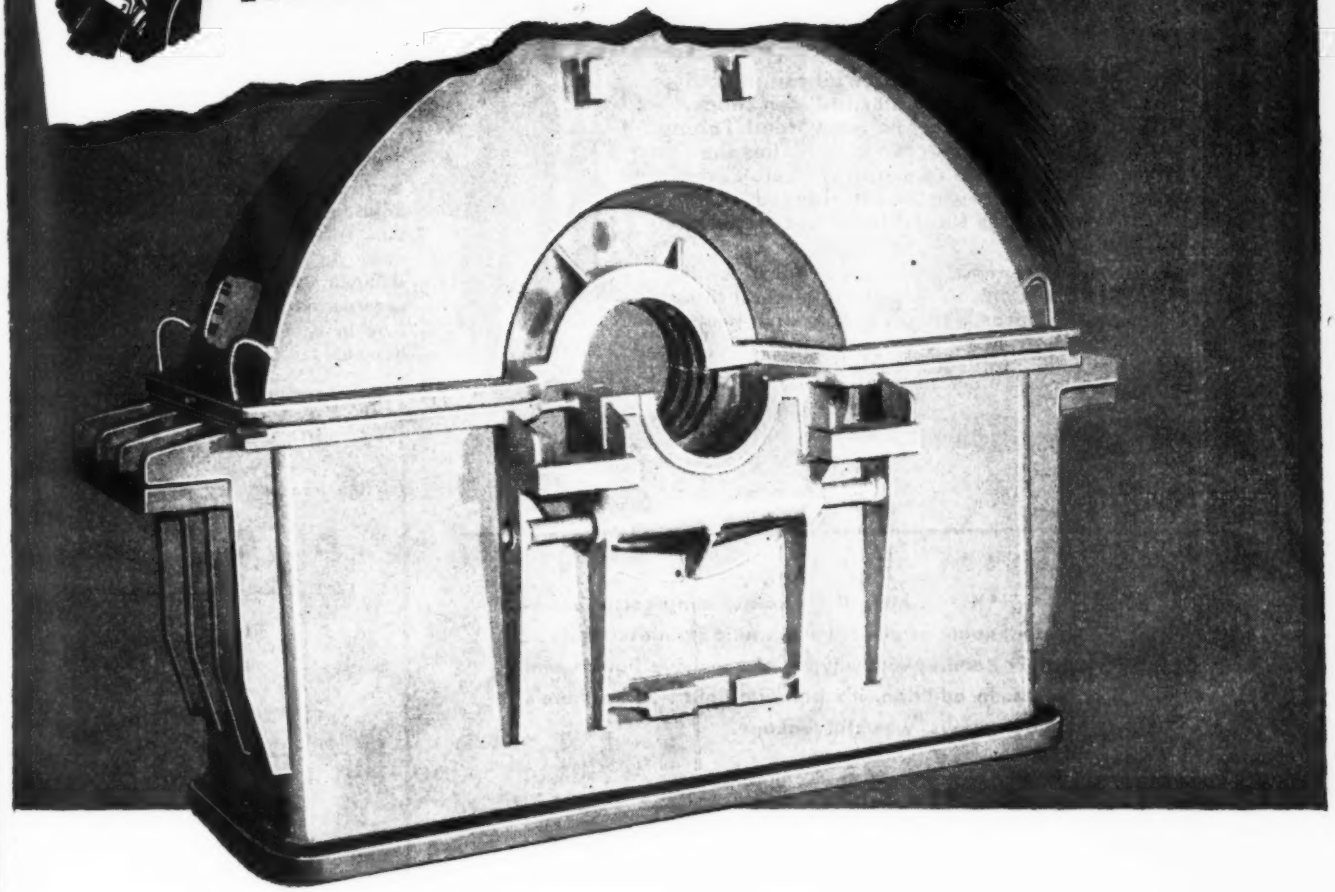
Welding Electrode

COMBINATION WELDING ELECTRODE, *Airco* No. 315, produces horizontal fillet welds with flat or slightly concave profiles and concave fillets in flat position, as well as fillet and deep groove. Applications include pressure vessels and their connections, heavy machine weldments, structural assemblies such as trusses, built-up girders and connections and practically all heavy-steel assemblies.

Airco No. 315 electrode has steady, force-

Why worry?

...USE ALCO WELDMENTS!



Here's Why: Weldments are becoming increasingly popular as a superior, more economical method of fabricating metal parts and products.

Of course. For one thing, rejects do not occur with weldments after machining starts. That means weldments *save worry and waste.*

For this reason, and other reasons stated below, weldments often *cost* less than any alternative available for the same service.

Another important angle is that there is a large body of skilled welders. Hence, schedules are less likely to be interrupted because of possible skilled-labor shortage.

ALCO guarantees to furnish engineering talent to design your product or part for production by ALCO weldments, and to produce such weldments as will ensure the following:

1. Complete machining without rejects due to faulty materials.
2. Prompt delivery.
3. Higher-quality product.
4. Less weight.

And remember, no item is too complicated for ALCO weldment design.

American Locomotive

ALCO PRODUCTS DIVISION

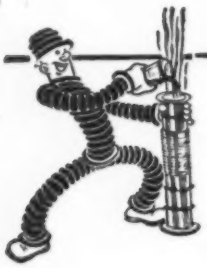
30 Church Street, New York 8, N. Y.
Dunkirk, N. Y.

REX-FLEX

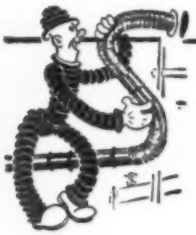
RESISTS { heat / corrosion / vibration

Wherever corrosion, excessive vibration, and heat are factors—alert production men choose REX-FLEX stainless steel Flexible Metal Tubing. For it effectively resists corrosion... has the extreme temperatures of stainless steel ... the extra flexibility to withstand prolonged vibration ... and is formable for use for virtually any application.

In scores of general and heavy industry jobs —REX-FLEX is minimizing flexible metal tubing connection failures, delivering topnotch performance. Find out what it can do for you. Write today for full information.



REX-FLEX . . . has all the outstanding corrosion-resistant qualities of 18-8 Austenitic Stainless Steel . . . safely handles many types of corrosive liquids and gases. In addition, it's pressure-tight . . . so there's no dangerous, wasteful leakage.



REX-FLEX . . . is easier to install, for it is manually bendable in multiple planes. Flanges and fittings are seam welded to form uni-metal assembly. This eliminates the hazards of solder . . . insures uniform strength and pressure-tightness throughout.

REX-FLEX . . . is available in 5 wall formations, unbraided or braided. Sizes range from 5/16" to 6" I.D. (incl.). The C.M.H. line of stainless steel units also includes REX-FLEX Inner Lined Exhaust Members and C.M.H. Bellows.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

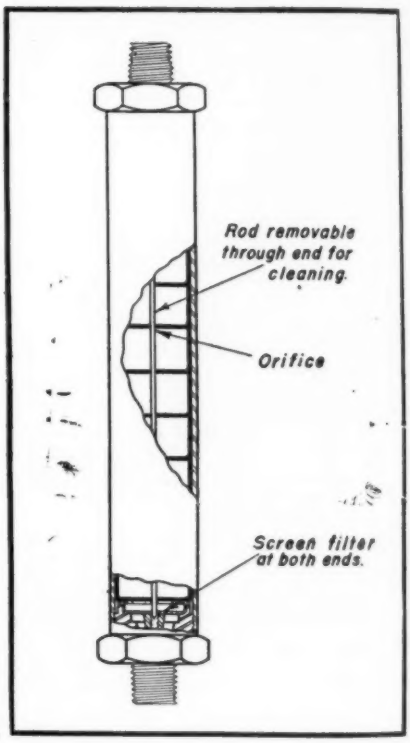
CMH CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

ful spray arc. Thick porous slag which completely covers weld deposit under practically every condition is removed readily. Electrode may be used with conventional technique, employing normal currents, under which conditions medium penetration is obtained. Deeper penetration is secured, however, when the deep fillet technique is employed with high currents recommended for this procedure. New *Airco* No. 315 can serve for any job that calls for a 6020 or 6030 electrode and may be applied with either ac or dc, straight or reverse polarity. **Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.**

Damping Unit

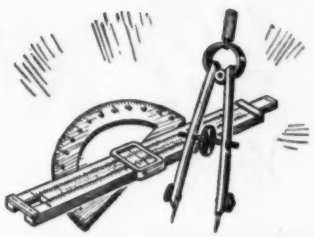
PULSATING DAMPING UNIT has no moving parts nor is there need for any external adjustment. It consists of a series of alternate small capacities or volumes and orifices. As pressure wave enters the device, a differential occurs across first orifice which causes a flow through it, thus raising pressure in adjacent chamber. This causes a flow through next orifice, producing similar



effects except with decreased intensity. While this "above-average" value of pressure wave is making its way through the series of chambers, pressure drops below average value (since it is a pulsating one) causing a reversal of flow process. Thus various capacities "breathe" with decreasing intensity as the waves pass through damping unit until finally a point is reached where pressure level lies just about at its average value.

To overcome difficulty of plugging, fine-mesh screens are at both entrance and exit of damping unit. In addition, a rod which passes axially through the series of orifices can be removed readily, thus exposing a large orifice area for simple and effective cleaning. Device is free of gaskets, and caps are welded to the tubes to provide

DESIGN*



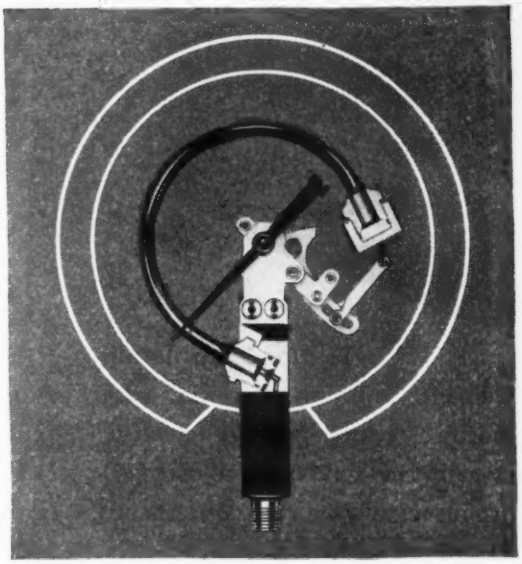
. . . . the expression of Marsh experience

THE design of a product expresses the "know-how" of the manufacturer behind it. All that we have learned to do in more than three-quarters of a century of instrument making stands before you in the design details of every Marsh pressure Gauge.

We are illustrating and describing only a few typical elements of Marsh design . . . the unit construction . . . the 270° bourdon tube . . . and the Marsh "Recalibrator". But Marsh design, developed in the tough school of Experience, carries into endless features of special gauges and into every detail of every gauge from the socket to the dial.

You have only to examine a Marsh Gauge to see the evidence of practical design, ingenious design, pleasing design—design that has real meaning as executed in quality materials and the painstaking workmanship that has made Marsh Gauges "The Standard of Accuracy".

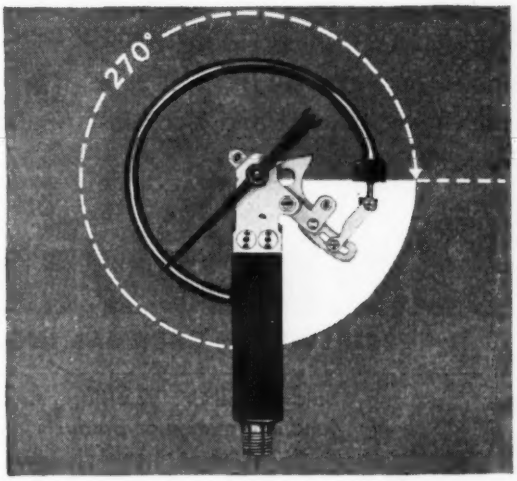
JAS. P. MARSH CORPORATION
2075 SOUTHPORT AVE., CHICAGO 14, ILLINOIS
Export Department: 155 E. 44th St., New York 17, N. Y.



Marsh "unit construction"—In Marsh Gauges, the working unit—bourdon tube, dial, movement and pointer—are assembled as a complete unit on the "socket" or bottom piece, the case merely serving as an enclosure as illustrated. As a result, external shocks are not transmitted to vital parts—one of the many reasons for the lasting accuracy of Marsh pressure Gauges.

The Marsh "RECALIBRATOR"

No story of Marsh design would be complete without the Recalibrator—the best way ever devised to restore the accuracy of a gauge that has been knocked out of adjustment. In most cases when the pointer of a gauge fails to return to zero when pressure ceases, the error is caused by a distortion of the bourdon tube. The ordinary way of correcting a gauge by removing and resetting the pointer does not correct the gauge throughout its entire range. The "Recalibrator" *does* correct the gauge throughout its range—by correcting for the distortion of the tube.



270° Bourdon Tube—Marsh dials are all evenly graduated; therefore highly legible. This is made possible by the 270° arc of the bourdon tube as illustrated—a design found by long experience to bring the travel and direction of movement of the tube into such a relationship with the linkage that each unit of pressure causes an exactly proportionate movement of the pointer.

*One of a series of advertisements covering factors that make Marsh Instruments "THE STANDARD OF ACCURACY"

MARSH GAUGES

DIAL THERMOMETERS
HEATING SPECIALTIES

B-H No. 1 *insulating* CEMENT

Your No. 1 choice for RUST RESISTANCE

B-H No. 1 Insulating Cement contains a special rust inhibitor which is fully effective even if the cement is allowed to dry out slowly on cold equipment. The metal surfaces which it covers will not be corroded. The bond between metal and cement will remain firm.

In *every* way B-H No. 1 Insulating Cement is ideal for maintenance work, especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

Because its basis is nodulated *black* Rockwool, high in resistance to both heat and moisture, B-H No. 1 Cement provides maximum insulating efficiency up to 1800° F.— even under the most humid conditions.

It can be stocked without breakage or loss, is easily applied even by unskilled labor, and is fully reclaimable when used at temperatures not exceeding 1200° F.

THE COUPON BELOW will bring you full information and a practical sample of B-H No. 1 Cement.

Baldwin-Hill

SPECIALISTS IN THERMAL INSULATION PRODUCTS

Baldwin-Hill Co., 523 Klagg Ave., Trenton 2, N. J.

Send information on products checked below:

☐ Free sample of B-H No. 1 Cement

☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)

☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.

☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____

FIRM _____

ADDRESS _____

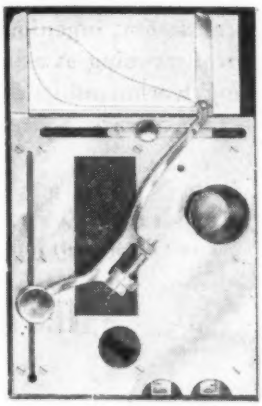
CITY _____ ZONE _____ STATE _____

leakproof construction. Unit is subjected to a static pressure test of 3000 psi and bears a working pressure rating of 1500 psi. Adapting the unit to liquid or gas service is made by one of the two rods supplied, the selection of which is made at installation. **Taylor Instrument Companies, Rochester, N. Y.**

Fuse Links

LINE OF HI-SURGE double-duty fuse links have low-current "N" rating of 1, 2 or 3 amp, each with a surge-blowing characteristic of a 5-amp conventional fuse link. Available in both universal cable and flip-open designs, they are mechanically and electrically interchangeable with conventional fuse links of the same kind now in service.

At transformer installations, now using 5-amp minimum fusing, new *Hi-surge* fuse links permit improved overcurrent protection with same freedom from fuse blowing as afforded by conventional 5-amp fuse links. With 1- 2- or 3-amp fusing, new links permit reduced blowing by lightning or other surge currents with same overcurrent protection as afforded by conventional fuse links. **General Electric Co, Schenectady 5, N. Y.**



Streamlined Planimeter

COFFIN-TYPE PLANIMETER, for determination of mean-indicated pressure from engine indicator diagrams, is simple to operate, requires no technical training and eliminates all calculating. It is furnished standard with pressure scales and instructions in a sturdy compact case. **Trill Indicator Co. 7000 Bennett St, Pittsburgh 8, Pa.**

Cement Dustproofer

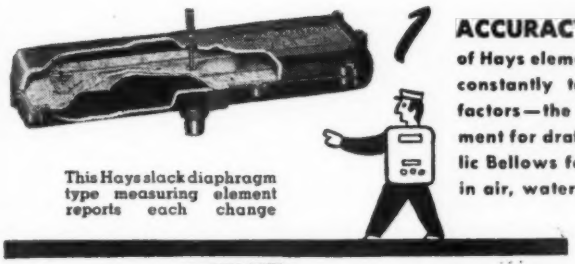
FAST-ACTING LIQUID, known as *Synkrete*, is a concentrate that is diluted with three parts water. It is then applied by brush, mop or sprinkler to saturate an area. It penetrates deep to fill the pores and reacts with the cement to harden into a rocklike, impenetrable mass. *Synkrete* dries in a few minutes so that floors remain usable although reaction is not complete for several days. A single application is sufficient to allay dusting, although two or three at 24-hr intervals are recommended for lasting results.

A gallon of concentrate forms four gal

ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!

HOW HAYS COMBUSTION CONTROL

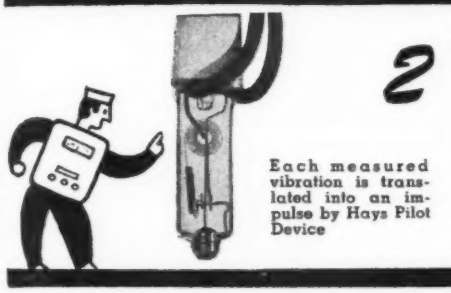
gives you 1 accuracy • 2 sensitivity • 3 speed • 4 power



This Hays slack diaphragm type measuring element reports each change

1 ACCURACY A CONSPICUOUS FEATURE

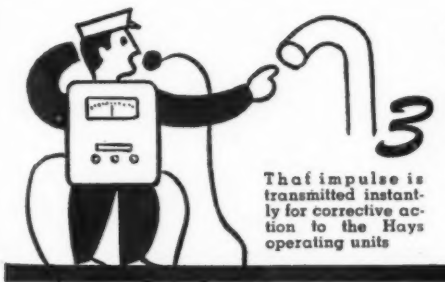
of Hays elements for measuring the minute changes constantly taking place in variable combustion factors—the Hays diaphragm type measuring element for draft and low pressures; and Hays Metallic Bellows for measuring steam or high pressures in air, water or oil.



Each measured vibration is translated into an impulse by Hays Pilot Device

2 TO CONVERT EACH MEASUREMENT

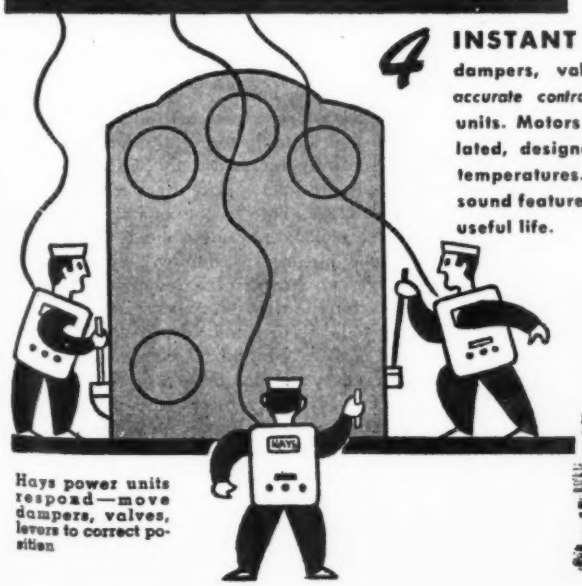
into an impulse calls for a pilot device of extreme sensitivity. The Hays pilot consists of two mercury switches magnetically operated. Fully enclosed, their contacts are effectively protected from dust, dirt, moisture; and blanketing with nitrogen prevents oxidation—a guarantee of long life.



That impulse is transmitted instantly for corrective action to the Hays operating units

3 THAT IMPULSE IS TRANSLATED

into corrective action, delivered instantly to the remote power units operating fuel feeder and air supply by electrical transmission. The Hays system possesses excessive starting torque—25 to 75 per cent higher than moving power—ample to overcome inertia and create quick action.



Hays power units respond—move dampers, valves, levers to correct position

4 INSTANT ACTION FOR MOVING

dampers, valves or levers *to the right point for accurate control* is the function of Hays power units. Motors are fully enclosed, effectively insulated, designed for installation in high ambient temperatures. Manual operation is available. Many sound features assure easy maintenance and long, useful life.

You SEE the 12 Vital Facts of MODERN COMBUSTION CONTROL in HAYS SALES VISUALS

The most comprehensive, most understandable explanation of automatic combustion control ever compiled. Ask the Hays representative to show it to you.

1. The purpose of Combustion Control.
2. How that Purpose is accomplished—3 methods of control.
3. What results can be expected of each.
4. Elements of a *good* control system.
5. Elements of a good controller.
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
8. How Automatic Combustion Control operates.
9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

This is the simple, dependable, automatic system that is saving big sums for industry of every kind—saving many man-hours, saving fuel, doing a better job, more dependably: Hays Electrical Combustion Control. A sensible way to see how it will help your business is by means of the Hays Visual Presentation. A line to us will arrange it.

The HAYS CORPORATION
SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

How To Give Stuffing Boxes
THE "BELMONT CURE"

FIRST STEP is to check pumps and engines for signs of leaking valves, pistons, rods and plungers.

THIRD STEP is to have a supply of standard Belmont Packings on hand so as to stop the leak at once with a packing that will do the job best and for the longest time.

SECOND STEP is to refer to Belmont PACKING RECOMMENDATION CHARTS which quickly identify the right packing type for each set of operating conditions.

BELMONT DISTRIBUTORS are located in every large industrial center, ready to serve you promptly from local stocks. Get the PACKING RECOMMENDATION CHARTS from the one nearest you — or send the coupon to us.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

on the blue-and-orange box

THE BELMONT PACKING AND RUBBER COMPANY
Butler & Sepviva Streets, Philadelphia 37, Pa.

Gentlemen: Please send PACKING RECOMMENDATION CHARTS for the services checked:

☐Steam . . . ☐Hot Water . . . ☐Cold Water . . . ☐Brine . . . ☐Ammonia . . .
☐ Acids & Caustics . . . ☐ Air . . . ☐ Gas . . . ☐ Oil . . . ☐ Gasoline . . .
☐ Asphaltic & Tar Products . . .

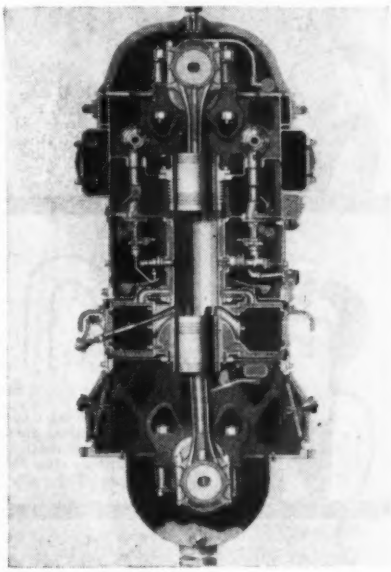
Name .....
Company .....
Address .....

of ready-to-use mixture and covers from 800 to 1800 sq ft per application. It can be applied over worn painted as well as unpainted floors. It is an excellent sizing after reaction is complete. Floors that are painted two to three weeks after treatment have far less tendency to peel or blister than unpainted floors. **Synthex Products Co, 2 W 45th St, New York, N. Y.**

Diesel Engine

MODEL 38 OPPOSED-PISTON ENGINE, designed and built before Pearl Harbor and widely used during the war years by the fighting services, is now available for commercial service. Use of the opposed-piston principle eliminates cylinder heads and valves, reduces moving parts, weight and bulk. There are two pistons in each cylinder, driven apart by a central explosion. One set of pistons drives a lower crankshaft, the other set an upper shaft. A vertical shaft consisting of upper and lower pinion shafts and a flexible coupling between connects the two crankshafts. Power is taken from the engine through a flexible coupling on lower crankshaft.

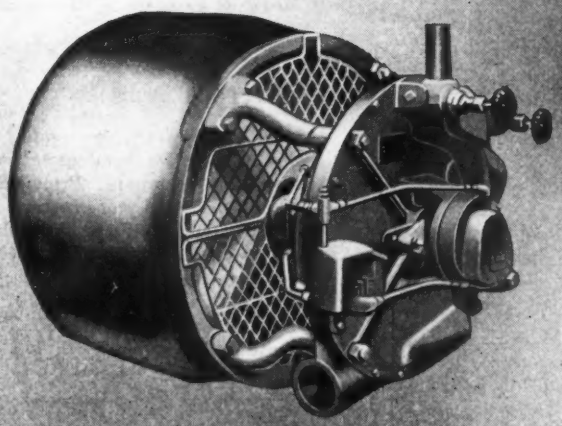
Cylinder blocks, identical for right- and left-hand engines, are of welded construction and contain compartments for control end, vertical-drive assembly, upper and



lower crankshafts, air passages, injection nozzles and exhaust manifold. The crankpan and suitable top and side covers form an entirely inclosed unit. Cylinders, consisting of liner, jacket, rubber rings and lock rings, bolt to the block. Liners are cast; jackets are rolled steel, welded. Oil-cooled pistons are identical, with an inner piston-pin bracket that eliminates a crossbore for the wristpin. Drop-forged connecting rods are of similar design but the lower rod is about 4 in. longer than the upper one. For each cylinder there are two injection pumps, of the constant-stroke single-valve rotating-plunger type, and two nozzles. Each nozzle is connected to its pump by short equal lengths of high-pressure tubing. Control is by Woodward governor.

A full-pressure lubricating system is provided and the cooling circuit is closed. A shaft-driven positive-displacement blower

WING



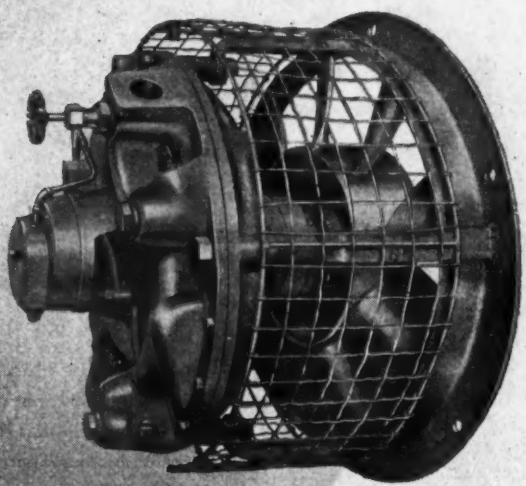
WING TURBINE DRIVEN BLOWERS

Type K

For Brickwall Mounting

Generally used for Stoker or Bagasse Firing where casing is cemented into Boiler Wall

Wing pioneered in forced-draft turbine blowers over a third of a century ago. Today Wing Turbine Blowers are in use in thousands of installations in many varied industries. They are simple and rugged in construction, quiet and dependable in operation. Oil-free exhaust can be used for heating, process or feed water.



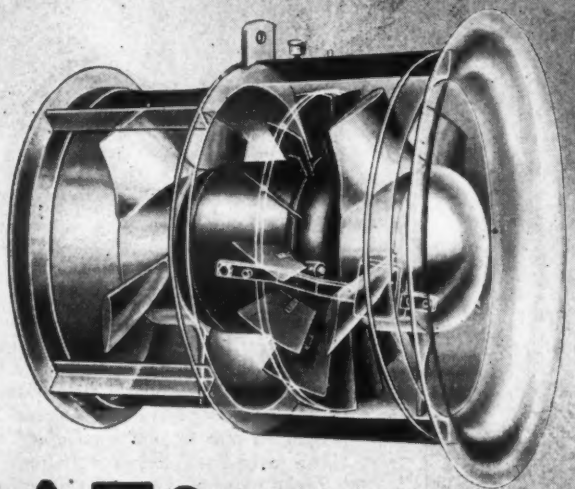
WING TURBINE DRIVEN BLOWERS

Type R

For Horizontal or Vertical Mounting on Wind Boxes or Air Ducts

Generally used for Oil Firing on Marine and Stationary Boilers, for Marine Ventilation, etc.

Ideal where use can be made of exhaust steam or where electricity is not available. Flexible capacity regulation by throttling steam to turbine—manually by hand valve or automatically by combustion control. Prompt shipments (no waiting for motors).



WING MOTOR DRIVEN BLOWERS

TYPE COM (TWO STAGE)

TYPE EMD (SINGLE STAGE)

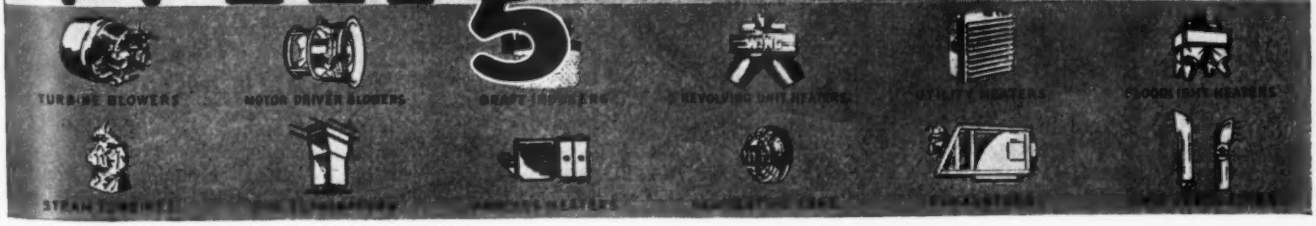
Wing Motor Driven Blowers are axial flow forced-draft blowers of simple, rugged construction, compact design and highest efficiency. Type EMD has capacities up to 50,000 CFM with statics to 5". Type COM can handle statics up to 30" on special designs.

Write for Bulletin SW-1

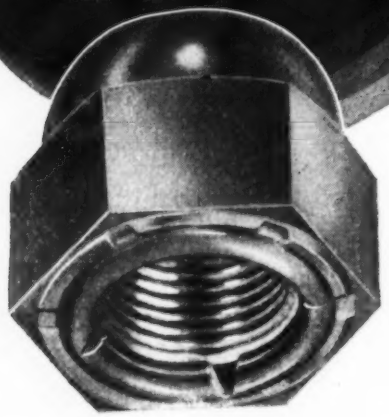
L. J. Wing Mfg. Co.

154 W. 14th St., New York 11, N. Y.
Factories: Newark, N. J. and Montreal, Canada

Wing AXIAL FLOW BLOWERS



now—
a real
cap nut



that locks!

COMPLETE PROTECTION of threads . . . thorough seal of liquids and gases even under pressure . . . positive locking grip that shock, vibration or impact can't loosen. There you have in the all-metal **An-cor-lox** a true cap nut; *plus* a lock-nut principle which long since has proved itself in the most rigorous of applications . . . a combination that for many important applications has not existed until this development. *Available in a wide range of shapes. Write for engineering data on both regular and cap-nut types.*

An-cor-lox
Lock Nuts

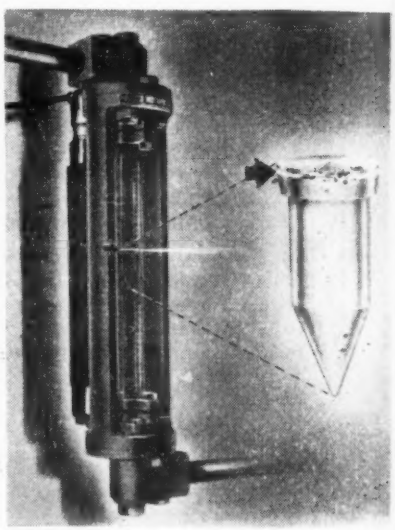
2276

An-cor-lox Division
LAMINATED SHIM COMPANY, INCORPORATED
61 Union Street • Glenbrook, Conn.

supplies scavenging air at 3 to 6 psi. Exhaust system consists of large water-jacketed passages built into the frame; manifolds are located on each side of the frame and exhaust ports completely surround the cylinders. Scavenging-air ports are at the liner top and exhaust ports at the bottom, giving a straight-through passage. Upper piston uncovers the air ports, and lower piston the exhaust. **Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago 5, Ill.**

Safety Glove

IDEAL FOR WELDING, new safety glove may also be worn for hand protection in other heavy-duty operations. Principal feature is its one-piece-back construction. There are no seams on glove back to catch sparks or molten metal. *Gunn* style reduces number of seams to a minimum. To give added strength and protection, all vulnerable seams are welted. **American Optical Co, Southbridge, Mass.**

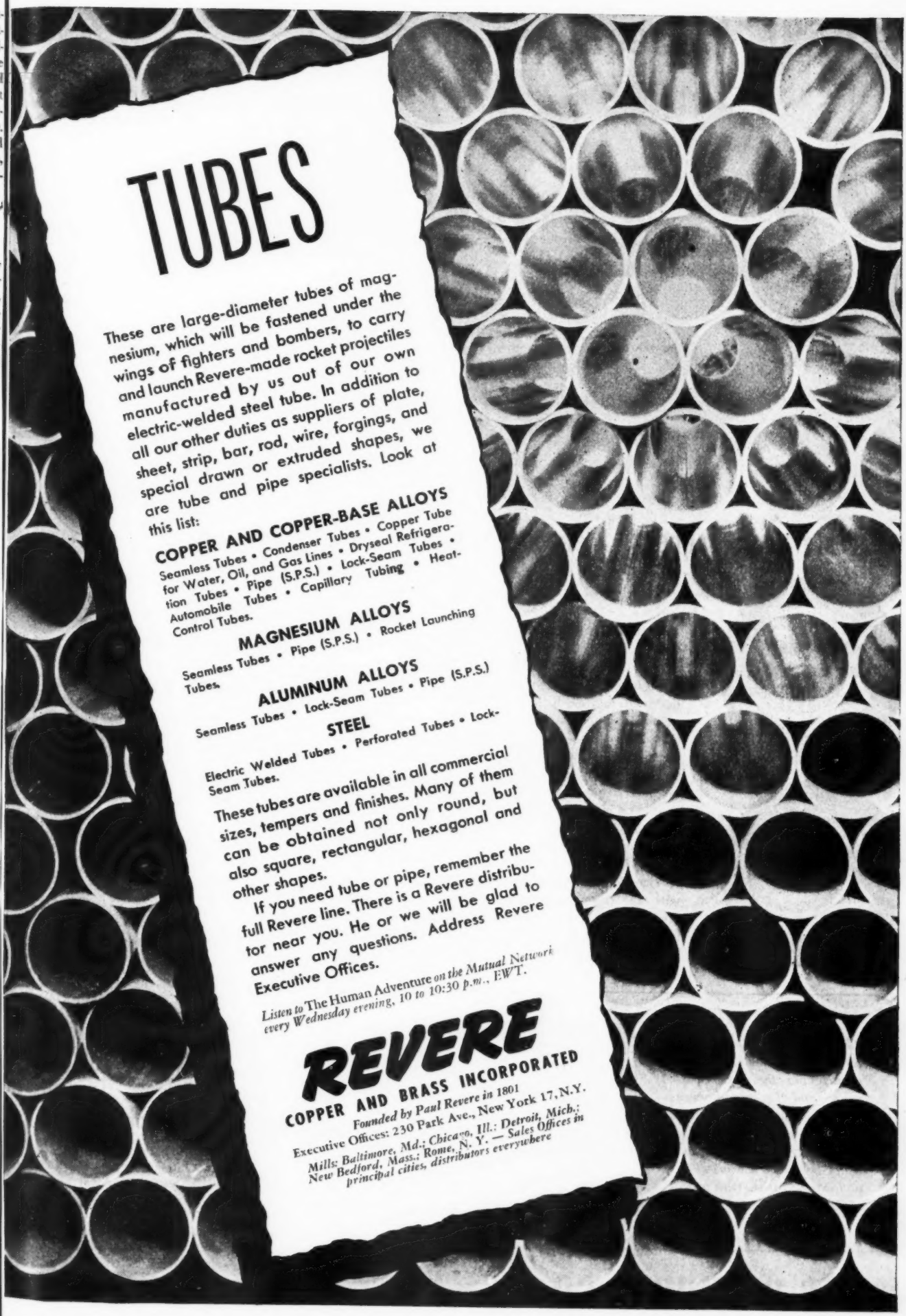


Rotor

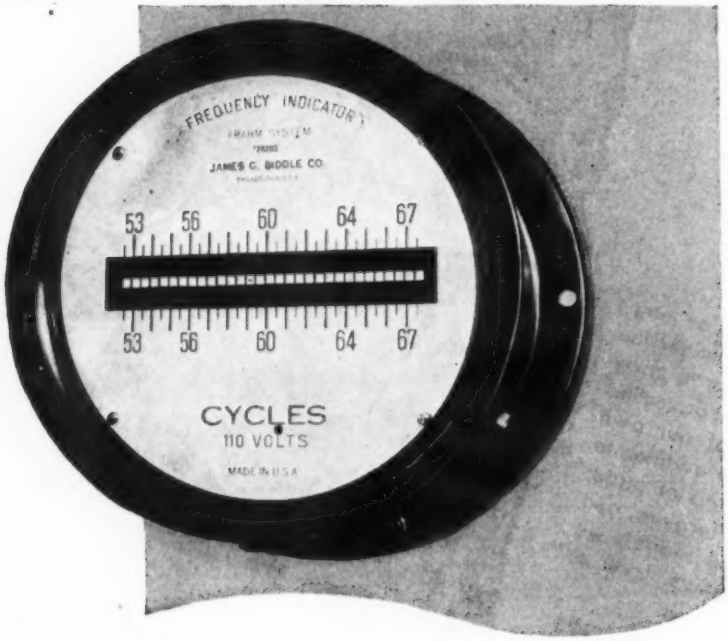
LINE-O-LIGHT ROTOR is for sharp, clear *Rotameter* readings of opaque liquids. This rotor, having same basic design as a standard SK rotor, has a disk of light-transmitting material sandwiched in rotor head, which reduces distance that light must travel through opaque liquid from its source behind tube. Flow rate is thus delineated sharply in resultant band of light on tube reference scale and operators can make easy, accurate readings. *Line-o-Light* rotor can serve for practically any application and in any tapered glass-tube *Rotameter*. Two kinds of disks can be furnished: Lucite for general applications and Pyrex glass for extremely hot or highly corrosive fluids. **Schutte & Koerting Co, 12th & Thompson St, Philadelphia 24, Pennsylvania.**

Mild-Steel Electrode

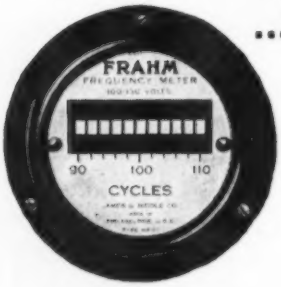
HARCAST ELECTRODE fuses well with either mild or medium carbon steel, thus making it ideally suited for joining cast iron with other kinds of steel. With a yield point

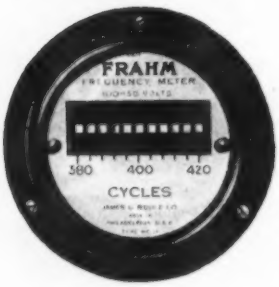

TUBES
These are large-diameter tubes of magnesium, which will be fastened under the wings of fighters and bombers, to carry and launch Revere-made rocket projectiles manufactured by us out of our own electric-welded steel tube. In addition to all our other duties as suppliers of plate, sheet, strip, bar, rod, wire, forgings, and special drawn or extruded shapes, we are tube and pipe specialists. Look at this list:
COPPER AND COPPER-BASE ALLOYS
Seamless Tubes • Condenser Tubes • Copper Tube for Water, Oil, and Gas Lines • Dryseal Refrigeration Tubes • Pipe (S.P.S.) • Lock-Seam Tubes • Automobile Tubes • Capillary Tubing • Heat-Control Tubes.
MAGNESIUM ALLOYS
Seamless Tubes • Pipe (S.P.S.) • Rocket Launching Tubes.
ALUMINUM ALLOYS
Seamless Tubes • Lock-Seam Tubes • Pipe (S.P.S.)
STEEL
Electric Welded Tubes • Perforated Tubes • Lock-Seam Tubes.
These tubes are available in all commercial sizes, tempers and finishes. Many of them can be obtained not only round, but also square, rectangular, hexagonal and other shapes.
If you need tube or pipe, remember the full Revere line. There is a Revere distributor near you. He or we will be glad to answer any questions. Address Revere Executive Offices.
Listen to The Human Adventure on the Mutual Network every Wednesday evening, 10 to 10:30 p.m., EWT.
REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
Executive Offices: 230 Park Ave., New York 17, N.Y.
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in principal cities, distributors everywhere

"FRAHM" Frequency Meters



What are your Frequency Measuring Requirements ...25...60...100...400.....1400 cps?





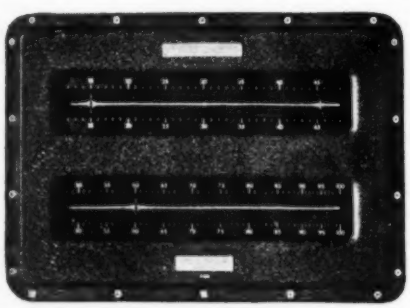
Frahm Frequency Meters in switchboard, miniature and portable types are regularly available for ranges between 15 and 500 cycles per second.

To meet special requirements, our laboratory has designed and built instruments for measuring frequencies as high as 1400 cycles. Such, we find, is possible by means of the same simple and direct resonant reed principle, usually requiring less than 0.1 volt-ampere power input, and without recourse to intermediate frequency conversion equipment. We believe that even higher frequencies are possible.

We invite correspondence regarding any frequency measurement problem in the audio and sub-audio range. For its solution we proffer our instruments, our services and facilities. In our 30 years of association with the resonant reed principle as applied to the measurement of frequency, we have been instrumental in the solution of a surprising variety of problems.

Write for Bulletin 1770-P now in preparation.

This instrument was developed for direct indication of frequencies in the lower audio range and for simultaneous direct indication of harmonic components. Called a Harmonic Analyzer, it has unusual electrical characteristics and a wide range, with a total of 288 reeds.

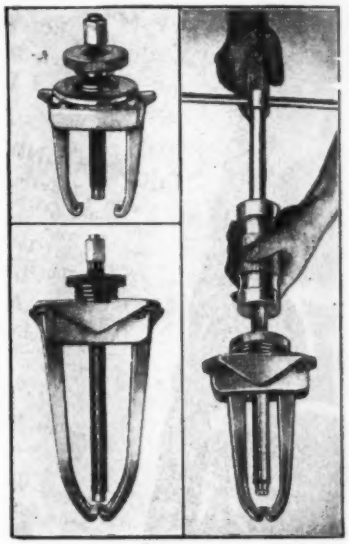


JAMES G. BIDDLE CO. **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

of 50,000 psi, the deposited metal has an ultimate tensile strength of 60,000 psi. Usable with ac or dc machines (straight or reverse polarity on dc) electrode works well at low amperage, thus minimizing dilution effect at fusion zone and permitting a higher quality of machining. Reverse polarity on dc produces a smooth bead with deep penetration. On dc straight polarity, penetration is less, higher beads are built and there is less spread in fusion zone. In either case, as with ac current, *Harcast* assures a sound, deep weld for any good grade of cast iron. **Welding Div, Harnischfeger Corp, Milwaukee 14, Wis.**

Gear Pullers

SERIES OF MATCHED GEAR PULLERS includes three sizes of standard pullers with maximum jaw capacities of 4½, 8½ and 14 in. Small and medium sizes are also available in slide-hammer design, or they can be furnished with parts to serve as either

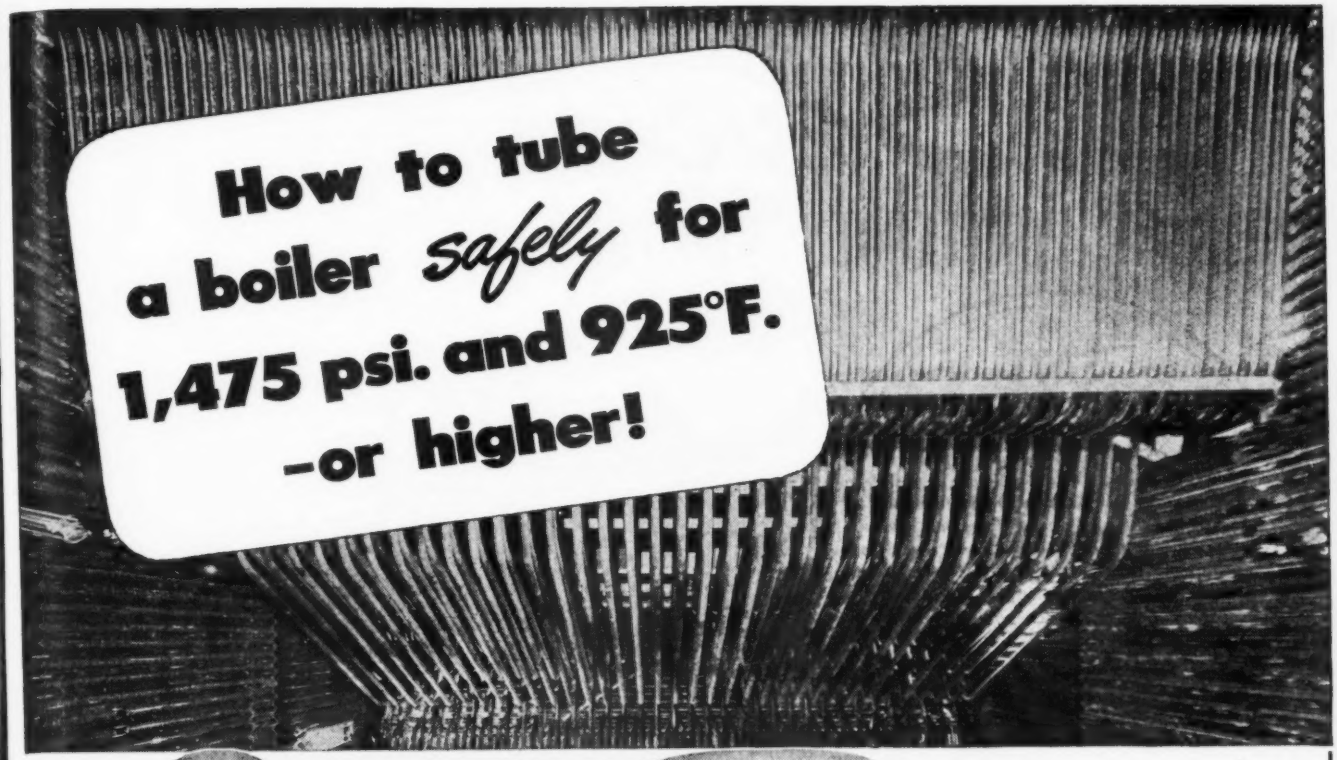


standard or booster hammer pullers providing perfect adaptability of puller to characteristics of each pulling job.

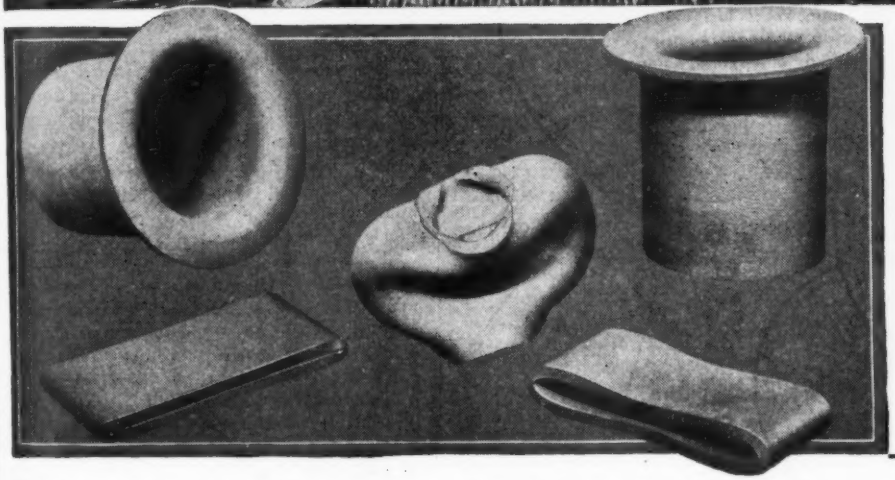
Yoke and jaw construction is identical on all models. Spring-controlled jaw lock gives a safe, slipproof and tipproof grip on part to be pulled. Long jaws allow utilization of puller where shaft extends some distance through gear or other part to be removed, and are slenderized to permit work in rather close places. Hexagon end of standard-model pressure screws can be turned with standard wrenches. Two smaller sizes take a ¾-in. wrench and the large model a 1-in. wrench. **Snap-On Tools Corp, Kenosha, Wis.**

Cold-Setting Plastic

CARDOLITE 5616 is a filling material for junction boxes, stuffing boxes, pot-heads and similar void spaces in electrical work. This liquid resin is mixed with Irvington 5612 setting agent prior to use. About four hours after mixing, the two ingredients gel at room temperature to point where flow is no longer possible. After several days end product is a tough rubbery mass which will not flow under heat nor become brittle



How to tube a boiler *safely* for 1,475 psi. and 925°F. —or higher!



LOOKING UP from the floor of this high-pressure, high-temperature boiler you see hundreds of boiler tubes—all NATIONAL Seamless—all one uniform quality.

CRUSHING, FLATTENING, *and flanging* tests showing good manipulating properties.

THE boiler shown above generates 615,000 lb. of steam per hour at 1,475 psi. and 925°F. While such pressures and temperatures are high, there are many boilers in existence that go even higher.

To meet these conditions, engineers and metallurgists at NATIONAL Tube Company have developed alloy boiler tubes so heat treated or annealed as to retain both maximum strength at high temperatures, and all the good manipulating properties at room temperature, which are necessary for expanding, rolling, and beading. This combination reaches its highest development only in a seamless tube. The same inherent characteristics make seamless easily the top material for power piping.

In fact, in many cases involving severe or hazardous service, the use of seamless pipe and tubing is mandatory. "Walls Without Welds"—pierced from solid steel—means absolutely uniform wall strength — no longitudinal line of potential weakness.

And for leadership in seamless, look to NATIONAL—the world's largest manufacturer of tubular products with widest experience, most complete facilities, the best "know how."

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

. . . Save WITH HENSZEY CONTINUOUS BLOWDOWN

SAVE EQUIPMENT

The Henszey Blowdown System prevents priming, foaming and carryover . . . and also prevents the formation of scale by simple chemical treatment of the feed water. Boilers last longer and tube burns are kept at a minimum. The resultant clean steam makes packings last longer — reduces turbine blade erosion—prevents sticking of reducing valves, traps, etc.—prevents superheater burnouts.

SAVE MANPOWER

The Henszey System is completely automatic. Boiler shutdowns and repairs are reduced to a minimum. No man hours lost unnecessarily replacing packings, repairing or replacing rods and cylinder rings, turbine nozzles, turbine blades, valves and other equipment along the line.

SAVE FUEL

The Henszey System offers complete, automatic blowdown without heat loss—a big fuel saving in itself. Then, too, boilers free from scale and sludge are more efficient — they require less fuel to produce the power load.

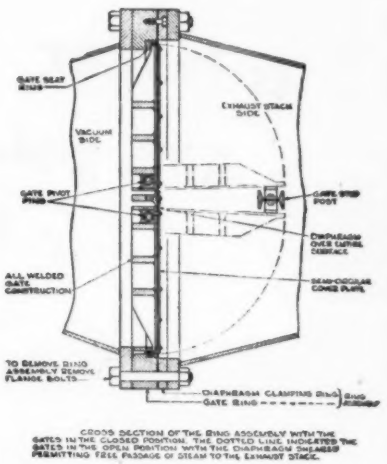
Plan now for postwar needs — send for details.

HENSZEY CO.
Dept. D9
Watertown, Wis.

HENSZEY
CONTINUOUS BLOWDOWN

Flow Indicators • Distillation System • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

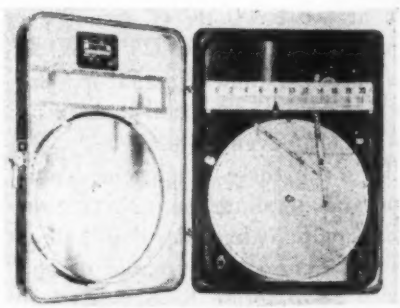
in the cold. Set compound is insoluble in water, oil, acids and alkalies. Although *Cardolite* 5616 adheres to metal, it can be stripped away cleanly to allow repairs to terminals and cable strips. **Irvington Varnish & Insulation Co. 6 Argyle Terrace, Irvington 11, N. J.**



CROSS SECTION OF THE RING ASSEMBLY WITH THE GATES IN THE CLOSED POSITION. THE DOTTED LINE INDICATES THE GATES IN THE OPEN POSITION WITH THE DIAPHRAGM SHEARED PERMITTING FREE PASSAGE OF STEAM TO THE EXHAUST STACK.

Relief Valve

ATMOSPHERIC RELIEF VALVE for condensing turbine-generators is light and compact, and requires no access structure, stem, packing gland or water seal. Valve protects a turbine against exhaust end damage should the unit go over to high pressure. Thin lead disk or diaphragm is sheared mechanically by swinging gates upon reversal of pressure. (See cross-section above.) This shearing is accomplished well below the allowable turbine exhaust-end pressure. Once valve has been called upon to operate, replacement of diaphragm is relatively simple. Special non-oxidizing acid-resistant grease protects working parts. Available in 6- to 42-in. sizes to relieve 10,000 to 550,000 lb of steam per hr, this valve is of all-welded construction. **M L Bayard & Co, 1945 Indiana Ave, Philadelphia 32, Pa.**



Potentiometer Controllers

FIVE BASIC electric potentiometer controllers are available now. Three are electric contact models, to be known as *Microact* controllers, and the other two are electric proportioning and current input types. Control units are mounted on the internal panel of the Bristol *Pyromaster* potentiometer recorder, and any model may be converted to any other type by following simple wiring and mounting instructions.

The three *Microact* units are provided

PLANT pioneers again with..

AT LAST! — THE OUTSIDE DIAMETER OF EACH SIZE OF PIPE COVERING IS MADE TO FIT EXACTLY INSIDE ANOTHER STANDARD PIPE COVERING SIZE!

It's another great "First" by PLANT, the pioneer of light-density type *Precision Molded* 85% Magnesia! Write for valuable "Digest Of Simplified Thickness Standards"!

LIGHT-DENSITY TYPE
PLANT
PRECISION MOLDED
85% MAGNESIA INSULATION
"THE DEPENDABLE STANDARD—MODERNIZED"

LONG DESIRED ADVANTAGES

✓ *FOR USERS!*

Odd Thicknesses Delivered Faster—Because they can be readily assembled from prime sizes!

Smaller Inventory! You stock only prime sizes to service every insulation need in your plant!

Easier, More Economical to Apply! Each layer of insulation fits exactly! No overlap to trim down, no gap to mud in with batch!

✓ *FOR DISTRIBUTORS!*

48% Fewer Items to Handle! Now stock only those special thicknesses best suited to local needs! Order prime sizes in Solid or Broken-Joint construction direct from us. We ship large lots direct to job for you!

Save Manpower, Materials, Money! Special thicknesses can be assembled without delay. Leftovers are all standard—readily usable.

REG. U. S. PAT. OFF.

PLANT RUBBER & ASBESTOS WORKS

GENERAL OFFICES: SAN FRANCISCO - PLANT Engineering Service Units in Principal Cities - FACTORIES: Emeryville, San Francisco, and Redwood City, Calif.

Army-Navy "E" Awarded to FACTORY No. 3 Emeryville, Calif.

Manufacturers of Plant Insulating Materials and Mechanical Packings. Established 1898.

*U. S. Patents Nos. 2,131,374, 2,209,752, 2,209,753, 2,209,754.

THE MOTOR PUMP LIN

AN INGERSOLL-RAND *Service*

The line of Motorpumps provides the most complete selection of pumping units within its range. (Capacities to 1800 gpm, heads to 600 ft.).

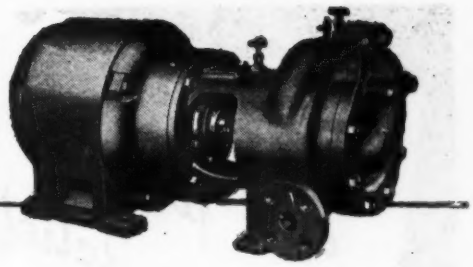
The Motorpump is a compact and efficient centrifugal pump having the impeller and the rotor of the motor on the same shaft. Pump and driver are a single rigid unit.

The same pump casing and parts combined with a turbine produce a similar compact turbine-driven pump.

Pumps are also available on cradles for any type of drive.

MOTOR-DRIVEN UNITS
RV with flanged pipe connections
(Left)—KRVS with fractional hp. motors
RVN with threaded pipe connections
TURBINE-DRIVEN UNITS
Available for pumps from 1" to 5" discharge sizes including single, two and four-stage units.
TRV single-stage unit
TMRV two-stage unit

1/4 To 50 HP.



TO ALL PUMP USERS

Where Motorpumps can be used — Motorpumps can be used wherever liquids must be pumped. Tens of thousands are in use in the petroleum, chemical, and other industries handling not only water, but an almost unlimited variety of other liquids.

Range of Sizes — Single-stage Motorpumps are available in discharge sizes from ¾" to 5" to handle capacities up to 1800 gal per min against heads up to 250 ft (110 lb per sq in). Two-stage and four-stage units handle up to 500 gal per min against heads up to 600 ft (260 lb per sq in). Often it is economical to use several Motorpumps together to obtain still larger capacities.

Modifications extending range of usefulness — Motorpumps are available in three standard material combinations; all iron, bronze fitted and all bronze, to handle a wide variety of liquids. Other modifications include open impellers for paper stock or viscous liquids, grease-sealed stuffing boxes or mechanical seals for petroleum products, hardened shaft sleeves and shrouded wearing rings for abrasive liquids, smothering glands, and water-cooled stuffing boxes for hot liquids, sling-yoke mounting for mine-shaft service.

Economical to use — Motorpumps are built on a production basis in a plant devoted exclusively to the manufacture of pumps. They are, therefore, economical in first cost. Moreover, they are quality units in every respect. Features such as heavy shaft, large ball bearings, sealed shaft sleeves and rigid construction assure long life. Their high efficiency keeps power requirements at a minimum. Their compactness cuts down installation cost and saves floor space which is often at a premium—they can be mounted on a wall or ceiling.

Availability — At one time we could and did say "Wire us for a Motorpump and we will ship it within 24 hours". We hope we can soon return to that basis. In the meantime, we can often give you shipments better than you expect under wartime conditions. Motorpumps are carried in stock by Ingersoll-Rand branch offices and by many dealers. This stock arrangement sometimes enables us to perform miracles even under today's difficulties.

* * * *

The Motorpump Catalog contains full information. Write our nearest branch for your copy—and for any engineering assistance. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

CRADLE-MOUNTED UNITS
for any type of drive
VERTICAL UNITS
For mounting directly on equipment such as machine tools, evaporative condensers, dairy machinery, washing machinery, etc. KRVS and RVN horizontal units are also suitable for such uses.
KRV short-shaft sidewall type
KRV immersion type

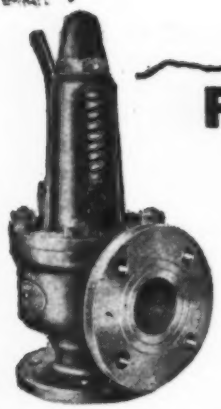
9-639

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

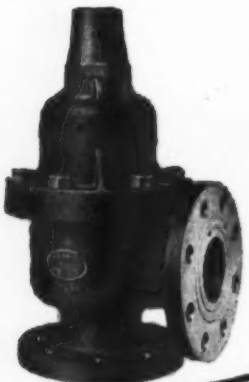
Rx For prompt relief— from Relief Valve troubles— use FARRIS!

You'll find these FARRIS FEATURES unique!



FARRIS exposed spring Relief Valve No. 1100. Naval type, high capacity, with test lever. For liquid and backpressure service; pressures to 350 lbs. at 500° F. Sizes ½" to 4".

Another FARRIS Liquid Relief Valve, No. 1450. Enclosed spring, pressure-tight cap. Also test-lever and pop types. Screwed outlet available. For pressures to 600 lbs. Sizes 2" to 8"



HIGH LIFT . . . accomplished by special FARRIS design, oversize springs, and "precision alignment." These features secure high-capacity discharge, necessary for the quick relief of over-pressure.

SPRINGS . . . protected from corrosive contact with discharged fluids. FARRIS springs are long, of carbon steel, low fibre stress, low pitch, and cadmium plated. Carefully calibrated to deliver accurate, dependable operation at the exact pressure set for relief action.

GUIDES . . . protected by FARRIS "precision alignment" from fouling; no sticking, or hanging due to distortion. Instant-action guarded!

SEATS AND DISCS . . . renewable — neither pressed nor rolled in. Special alloys and heavy construction fortify wear-resistance. FARRIS "Precision Alignment" produces tight precision reseating instantly after over-pressure is relieved, which minimizes the duration of relief action for economical operation.

Drop us a line with full details of your Relief or Safety Valve problem. Our Engineering Department will gladly furnish recommendations for the proper valve — without obligation on your part!

Write today for our Specifications Bulletin

FARRIS ENGINEERING COMPANY

366 Commercial Ave., Palisades Park, N. J.

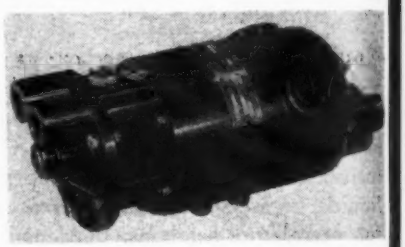
Farris

SAFETY and RELIEF VALVES

with one, two and three precision toggle switches respectively and six different terminal-board connection arrangements to meet a wide assortment of control-circuit requirements. Proportioning controller may be used with any electric proportioning valve and may be had with resetting contacts if required. The proportioning current-input controller provides close temperature control of electric furnaces and ovens. **Bristol Co, Waterbury 91, Conn.**

Pipe Seals

PLASTIC PIPE SEALS and thread protectors are made in countersunk pattern now as well as in squarehead pattern. The strength and lightness, as well as toughness, of plastic makes it ideal for pipe seals and thread protectors. Plastic takes accurate and durable threading, is noncorrosive, dielectric, and excludes moisture, oil, dirt, grit, etc. Square sockets of countersunk pattern are of dimensions to fit commercial square bars of standard sizes. Dimensions are the same as maximum size of cold-rolled square steel bars given in ASTM specifications. Sizes available are ⅛, ¼, ⅜, ½, ¾ and 1 in. **American Molded Products Co, 1644 N Honore St, Chicago 22, Ill.**



Dry-Air Pump

MOTOR-DRIVEN explosionproof dry-air pump eliminates oil filters, separators or accumulators in the system and provides air free of oil contamination. Oil-free discharge removes explosion hazard in applications where electrical discharges occur. As pump requires no lubrication, it can be mounted near its supplementary equipment or in inaccessible places. Pump is a rotary, single-vane model, the vane being held against rotor by pressure exerted through dual helical springs. Finned-rotor housing design dissipates heat rapidly. Pump provides a theoretical air flow of 4.1 cfm at 10,000 rpm. **Eclipse-Pioneer Div, Bendix Aviation Corp, Teterboro, New Jersey.**

Control Relay

FOR RELAYING OUTPUT of electronic apparatus and instruments, such as pyrometers, etc, and for general control functions, Type WT relay is suitable for both ac and dc service. Of double-pole design and with poles electrically insulated on the moving arm, a wide selection of circuits is possible. On ac, relays are available with single-pole auxiliary contacts of normally open double-break design.

Main contacts are rated at 10 amp, 300 v

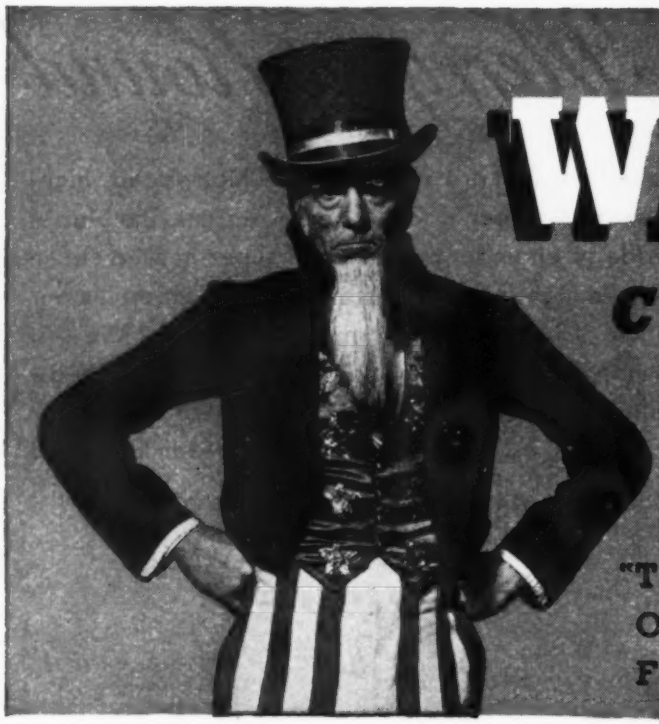
High-Temperature Merry-go-Round

Stainless steel blades are used in these high-speed, high-temperature steam turbines for a number of reasons. The blades must not corrode or pit under the action of super-heated steam while travelling at high speed and they must not "creep" under the combination of high temperature and centrifugal stresses.

There are many applications in industry where a tough heat-enduring metal like this means longer life, fewer shutdowns, and more economical operation. Have you tried stainless steel?

BUY UNITED STATES WAR BONDS AND STAMPS

Other interesting uses of stainless steel are described in ELECTROMET REVIEW published by ELECTRO METALLURGICAL COMPANY, the Unit of UNION CARBIDE and CARBON CORPORATION that produces alloys for making steel. If you are an executive, engineer, or designer you can be put on the mailing list for ELECTROMET REVIEW by sending your name on your business letterhead to ELECTRO METALLURGICAL COMPANY, Room 328, 30 East 42nd Street, New York 17, N.Y.



WARNING

COAL CRISIS IMPENDING!

HAROLD L. ICKES
Fuel Administrator, Says:

"THE WORST FUEL SHORTAGE OF THE WAR IS THREATENED FOR THIS COMING WINTER!"

INDUSTRY MUST CONSERVE COAL

-Clark Fluid Controls will help you do it!

WATER AND AIR IN STEAM PIPES CAUSE EXCESSIVE USE OF COAL

When water condensate or air is permitted to remain in steam pipes, heat transfer is curtailed, pressure goes down and the consumption of fuel goes up. Furthermore, excessive condensate often causes "water hammer" which is dangerous to both piping and equipment. Do not permit these to happen this winter. Inspect your steam system and install Clark Traps where needed. Clark Traps save coal, increase steam efficiency and help protect steam systems and equipment.

CLARK TRAPS REMOVE CONDENSATE AND AIR WITHOUT STEAM LEAKAGE

While draining water and air from steam systems it is important that there be no leakage of steam. Coal is needed to produce steam—and coal will be precious this winter.

Steam leaks are costly—and sometimes create harmful back pressures in return lines. In vacuum systems, steam leakage tends to reduce or destroy the vacuum, overloading vacuum pumps, increasing operating costs and oftentimes slowing up and even stopping the return flow of condensate.

Clark Steam Traps operate without steam leakage. The effective valve mechanisms and "Clark-loy" precision lapped discs and seats prevent leaks.

It will pay you to specify "Clark" when you need steam traps or other fluid controls.

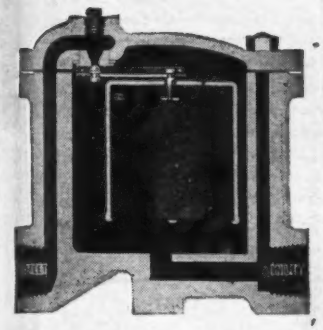
Clark

FLUID CONTROLS

Clark
FLUID CONTROLS

SAVE COAL AND MONEY

Remove costly air and water condensate. Increase steam pressures. Accelerate plant production.



Clark Series "70" Steam Traps
Sizes ½", ¾" and 1". For Pressures to 200 P.S.I. Semi-steel Construction. "Clark-loy" Disc and Seat. Patented Bucket Vent. See Catalog T-1451.

CLARK OFFERS A FULL LINE OF FLUID CONTROLS FOR EVERY TYPE OF INDUSTRY

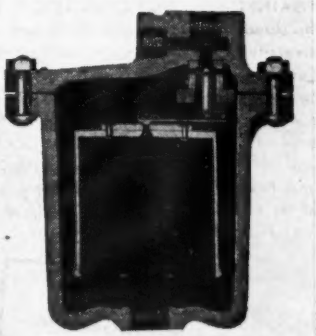
Although only four Clark products are pictured here, you'll find a complete line of Fluid Controls in the Clark Line—Steam and Fluid Traps, Inverted Bucket, Upright Bucket and Float Types, Vacuum and Lifting Traps, Pressure Regulators, Valves and Reducing Valves, Strainers and other fluid controls.

CLARK FLUID CONTROLS ARE DOUBLY TESTED

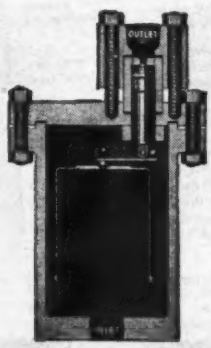
Every Clark Trap is subjected to a rigid hydrostatic test. Hot water at double operating pressure is used to detect casting flaws. To assure correct, dependable operation, all Clark Traps are next tested on special test equipment. Traps are discharged to atmosphere to permit close observation of both operation and rate of flow under varying test conditions.

AN OLD PRODUCT TAKES A NEW NAME

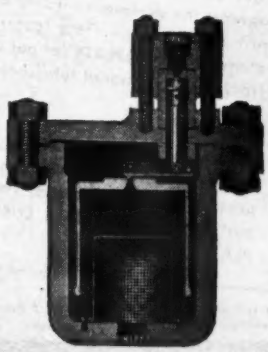
For almost four decades The Clark Manufacturing Company has manufactured a high quality line of fluid controls. Beginning July 1 of this year the complete line of steam specialties made by Clark assumed their own identity and are now offered to industry under the name "Clark Fluid Controls." Specify "Clark" and you get the finest in Steam Traps and Reducing Valves.



Clark Series "80" Steam Traps
Sizes ½" to 2½". For Pressures to 250 P.S.I. Semi-steel Construction. Dual Outlet. "Clark-loy" Disc and Seat. Patented Bucket Vent. See Catalog T-1451.



Clark Series "900" Steam Traps
Sizes ½" to 2". Fabricated Welded Steel for Pressures to 600 P.S.I. Externally Bolted-in. Heat-treated Alloy Ball Type Disc and Seat. See Catalog T-1451.



Clark Series "800" Steam Traps
Sizes ½" to 2". Forged Steel for Pressures to 1800 P.S.I. Built-in Strainer. External Discharge Valve. Patented Bucket Vent. See Catalog T-1451.

THE CLARK MANUFACTURING COMPANY

★ CLEVELAND 14, OHIO ★

LUBRIPLATE No. 130-A

LUBRICATION PLUS!

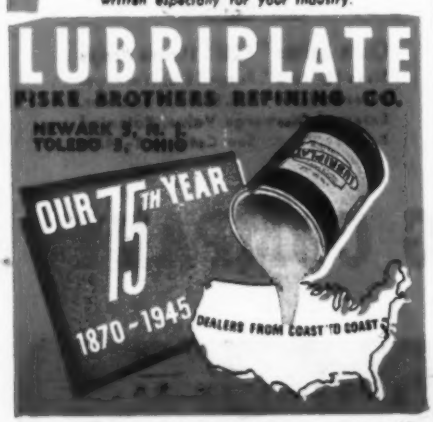
A SUPER LUBRICANT—A MARVELOUS ANTI-SEIZE COMPOUND—A REAL PROTECTION AGAINST RUST AND CORROSION. From the standpoints of general utility and wide diversity of important uses, we do not believe there has ever been a lubricant that compares with LUBRIPLATE No. 130-A. It has everything. The outstanding performance of this super-lubricant and its adoption by industry in general, and the Army and Navy are certainly adequate proof of its superiority. Write for copy of bulletin No. 6-41.

LUBRIPLATE
Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE
Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE
Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

Write for a booklet, "The LUBRIPLATE Film" written especially for your industry.



and may also be used on circuits up to 600 v under certain conditions. Contacts are silver to silver, including auxiliary contacts on ac relays. Relay is mounted on a thick-molded base for direct mounting on metal bases. Front-connected relays are standard. Optional rear-connected relays are furnished with stands extended through back of base. **Electric Controller & Mfg Co, 2700 E 79th St, Cleveland 4, Ohio.**

Diesel Fuel-Oil Concentrate

ESPECIALLY PREPARED as an additive to diesel fuel oils (4 oz to each 10 gal of regular diesel fuel oil) *Gibraltar* diesel fuel-oil concentrate prevents injector nozzles corroding and sticking, and gives top cylinder lubrication, thus preventing formation of hard carbon and sticking rings. Any carbon that is formed is soft and, because metal pores are impregnated with oil capable of withstanding high temperatures, carbon is expelled from engine through ports. Concentrate decreases fuel consumption by giving better lubrication and by compounding noncombustible components of fuel oil itself, which ordinarily become carbon. Concentrate is manufactured from a light mineral-oil base and mixes thoroughly without agitation with any regular fuel oil. **Hood Refining Co, 106 N Hamilton Ave, Greensburg, Pa.**

Hoist Drive

MAXSPEED SYSTEM, which automatically "measures" the load so that it is hoisted and lowered at maximum safe speed yet prevents handling of dangerous overloads, is for either indoor overhead, slow-speed cranes or high-speed cranes for outdoor construction. Drive operates from either ac or dc incoming power. **General Electric Co, Schenectady 5, N. Y.**

Engine-Pressure Indicator

SIMPLIFIED PREMAX MODEL YRF engine-pressure indicator is for direct reading of compression and firing pressures of any diesel engine at any engine speed or rate of pressure rise. Counter locks automatically when maximum pressure in cylinder shows on dial. This feature makes it practically impossible to make a mistake in reading. Only one figure appears in window of counter and this figure represents actual maximum engine pressure in psi.

Operation is based on principle of balancing maximum cylinder pressure by force of a precisely calibrated helical spring and then measuring deflection of spring. Successive pressure readings may be taken rapidly with indicator as no venting is required between readings. Calibration of instrument is permanent, according to manufacturer, even if it is exposed to overpressure, shock or severe usage. Indicator indicates cylinder pressure up to 1700 psi. No adjustments or settings are required in field to compensate for instrument characteristics, purpose of test or engine conditions. **Bacharach Industrial Instrument Co, 7000 Bennett St, Pittsburgh 8, Pa.**

LUBRIPLATE No. 70

LUBRICATION FOR WHERE IT'S HOT AND WET!

LUBRIPLATE No. 70 is a medium density, grease type lubricant ideal for applications exposed to heat, steam and moisture. It does a wonderful lubrication job under all conditions. In processing and food plants where moisture, steam, heat and fumes are prevalent, it has no substitute. Machines lubricated with LUBRIPLATE No. 70 can be washed down with hot water without harming the lubricant in the bearings. LUBRIPLATE No. 70 prevents rust and corrosion.

Rx FOR YOUR MACHINERY

No. 3—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers)

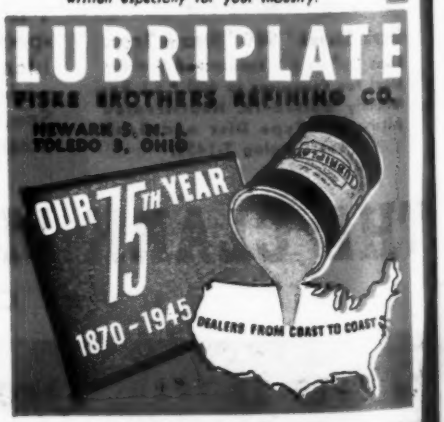
No. 107—One of the most popular grease type products for general application by pressure gun or cups.

No. 70—For a wide range of grease applications, especially at temperatures above 200 degrees F.

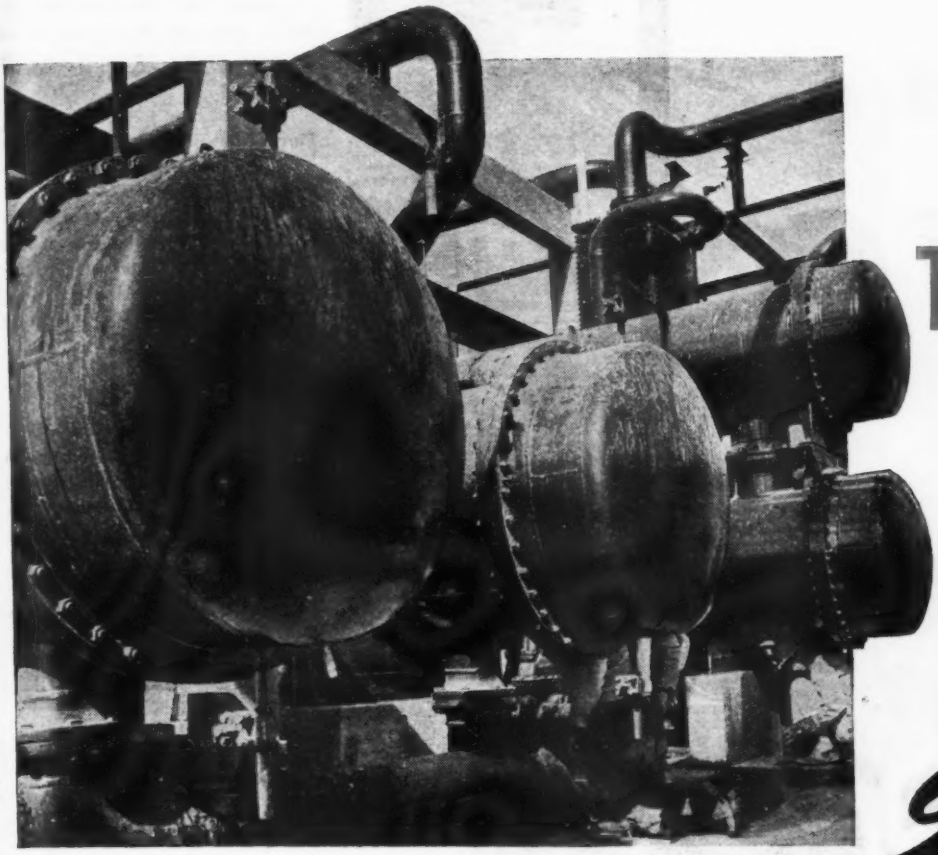
No. 130-AA—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

Write for a booklet, "The LUBRIPLATE Film" written especially for your industry.



PROTECT YOUR HEAT EXCHANGERS FROM THE START



with this old age Security

● One of the best ways to insure substantial old age benefits for your heat exchangers is to tube them with Republic ELECTRUNITE Tubes. Use carbon steel for ordinary service and one of the stainless steels for more severe service.

ELECTRUNITE Tubes are free from corrosion-inviting scale and scale pits. And they're as clean and free from defects inside as out—because the inside surface is open to inspection before forming into a tube.

Then, when they finally wear out, they'll save you time in retubing, too—and thus shorten down-time for repairs. They slide in freely, roller expand and bead over smoothly and rapidly—because they're uniform in diameter, in wall thickness and in ductility. Full normalizing permits you to cut tubes at any point—yet enjoy the same ductility as at original ends.

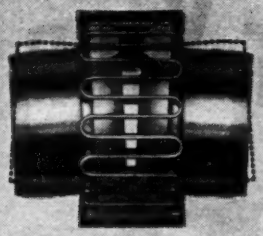
More than 150,000,000 feet of ELECTRUNITE Pressure Tubing installed to date have written the story of their safety and economy on the records of ELECTRUNITE users. They can do the same for you—and we're ready to tell you how.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

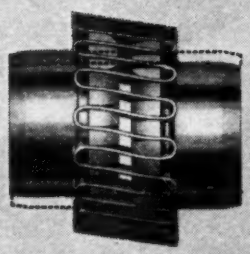
REPUBLIC STEEL
PRODUCTION FOR VICTORY

Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

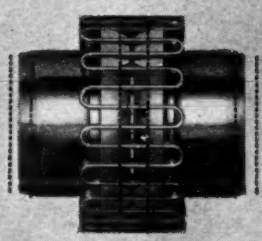
ALL THIS



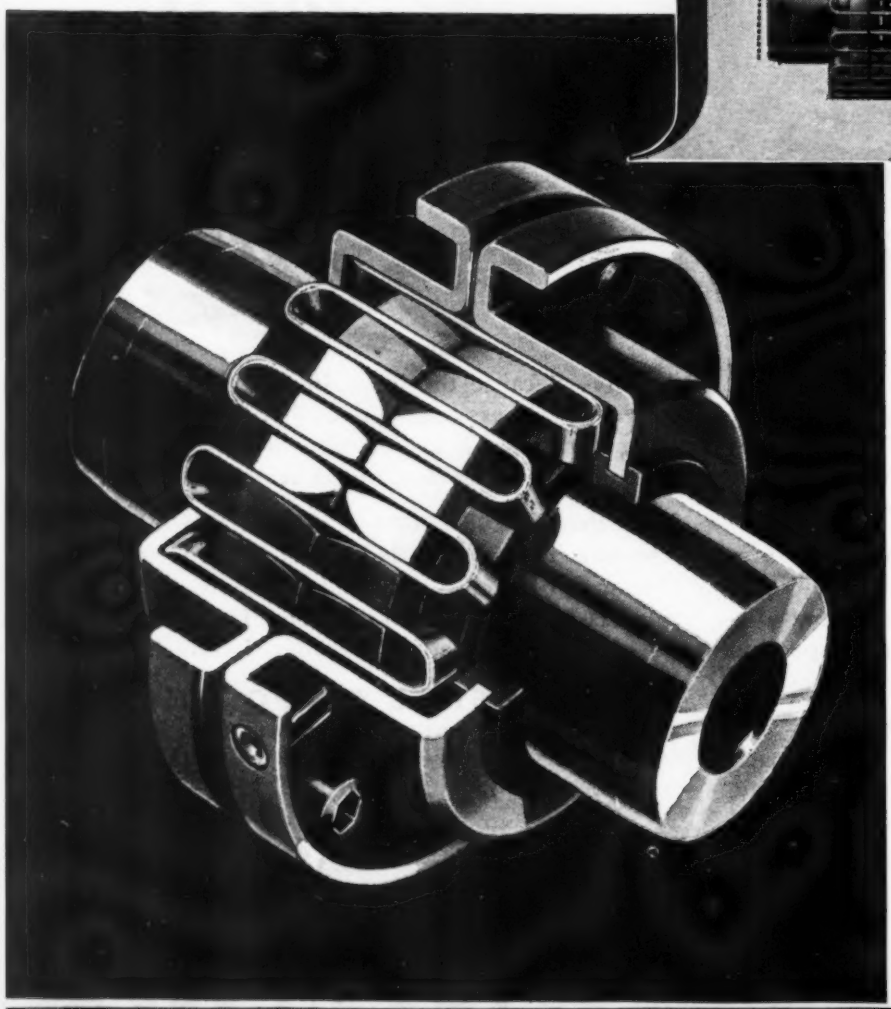
Angular Misalignment. Under angular misalignment the design of the Falk Steelflex coupling permits a rocking and sliding action of lubricated grid and hubs that allows the greatest freedom of accommodation to angular misalignment, while at the same time transmitting the power through the resilient grid with no lost motion or backlash.



Parallel Misalignment. When parallel misalignment is involved, the resilience of the grid-groove combination comes into full play. The movement of the grid in the lubricated grooves accommodates the misalignment, while still permitting full functioning of the grid-groove action of the coupling in absorbing shock and dampening vibration.



Free End Float. Because the grid member slides freely in the lubricated grooves, the Steelflex coupling permits free and independent end float for the shafts of both the driving and driven members, or of either one. If it is desired that end float be restricted, provision can be made to limit it to any required amount.



Why the Falk Grid-Groove Design Gives you a Plus Value Coupling

Many different kinds of couplings are available. Almost any of them will, to a degree, correct angular misalignment.

To probably a lesser degree, they will correct parallel misalignment, and, if provisions are intentionally made, they will permit a certain degree of end float. But it is the manner in which they provide for these corrections that determines their value to you.

Falk Steelflex Couplings do well-nigh perfectly all that a coupling should do and, in addition, they provide torsional resiliency in addition to flexibility. This is a definite plus value.

IT ALWAYS PAYS TO CONSULT FALK

...and TORSIONAL RESILIENCE, Too!

Because of the Grid-Groove Design of FALK STEELFLEX COUPLINGS

Here's How It Functions... Falk Steelflex Couplings are conspicuous because of their grid-groove design... The grid-groove design is the net result of long experience in gear design... This is important, because in most cases a coupling is used in conjunction with a driven machine involving the use of gears... The long experience of Falk engineers in designing gears has been responsible for coupling design which not only provides the flexibility long considered essential bu also provides the torsional resilience which enables Fal Steelflex Couplings to transmit power smoothly, efficientl with an almost total elimination of the effects of shock, t dampen vibration, and to cushion the load even under sever peak loads... Here is a very simple exposition of how th Falk grid-groove design imparts unusual performance

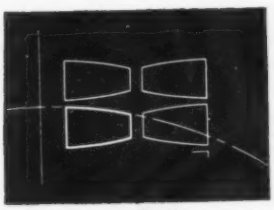


Fig. I

FIG. I. Grooves, in a precise arc, and with a radius and length proportional to the size of the coupling, are cut into two identical hubs of moderately high carbon steel—forged or Falk alloy cast steel... **FIG. II.** These grooves provide a snugly fitting slot for a grid member made of chrome alloy steel with an elastic limit of 180,000 pounds per square inch and an ultimate strength of 220,000 pounds per square inch... **FIG. III.** This grid fits snugly into the curved grooves cut into the hubs of the coupling. The grooves provide a scientifically cut bearing surface for the grid. This bearing surface extends from the outer to the inner edge of the hubs. The grid bears on the grooves in proportion to the load... **FIG. IV.** Under light loads, the grid bears only at the outer edges of the grooves. This permits a long, free, elastic span between the outer edges of both hubs. Powe Is transmitted through almost th entire length of the grid rung... **FIG. V.** Under normal loads, th grid bears on a larger area of th grooves and the span of the gri rung is automatically shortened a the load increases. It transmits mor power without increasing internal stress and maintains its capacity to absorb shocks, dampen vibration and cushion the load... **FIG. VI.** Under peak loads, the grid rungs bear over almost all of the curve surfaces of the grooves. The span of the grid rung becomes very short The coupling still remains torsionally resilient. Under the impact of shocl loads the grid flexes and continue: to transmit power smoothly and effi ciently.

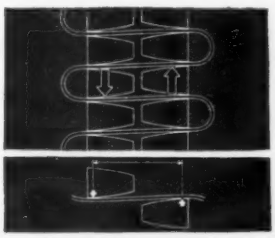


Fig. IV

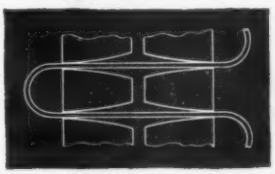


Fig. II

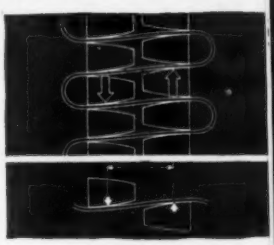


Fig. V

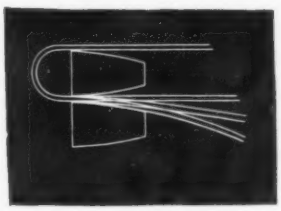


Fig. III

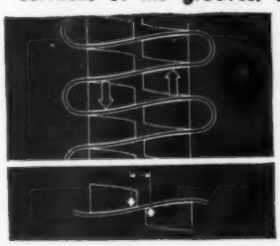


Fig. VI

There are 13 types and 33 sizes of Falk couplings to meet all requirements. (Get the more detailed information, including Torque Deflection and Stiffness Factor Curves, which is available to you upon request). For specific information and recommendation to meet your needs, call the nearest Falk representative or distributor.

THE FALK CORPORATION, MILWAUKEE 8, WISCONSIN

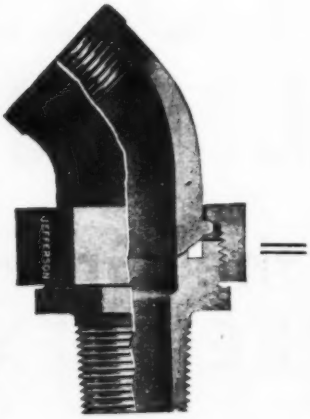
For over fifty years precision manufacturers of Speed Reducers... Motoreducers... Flexible Couplings... Herringbone and Single Helical Gears... Heavy Gear Drives... Marine Turbine and Diesel Gear Drives and Clutches... Contract Welding and Machine Work. • District Offices, Representatives, or Distributors in principal cities.

FALK... A GOOD NAME IN INDUSTRY

JEFFERSON
Specialty UNIONS

with the Recessed Brass Seat

Good for years of care-free, leak-proof satisfaction



Jefferson 45° Union Elbows are recommended for unusual piping installations because they are time, space and money-savers as well as the means of eliminating unnecessary pipe joints. The All-Female Union Elbow takes the place of a straight union, nipple and a 45° elbow, thereby eliminating two pipe joints; the Male and Female Elbow combines the advantages of the All-Female Elbow with the Male and Female union.

All Jefferson Unions, standard or Special, have the exclusive Jefferson Recessed Brass Seat which makes for leak-proof tightness, leaves bore straight and unobstructed and assures make up without undue pressure.

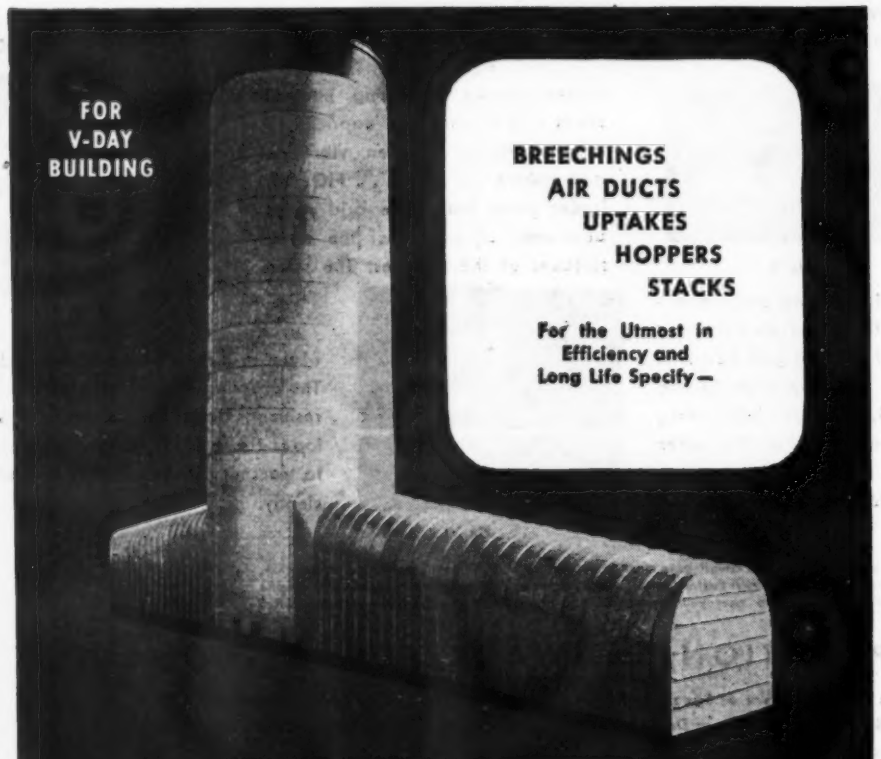
Get full information today from your nearest distributor or by direct inquiry to us

JEFFERSON UNION CO.

601 West 26th St., New York 1, N. Y.

Factories at

LEXINGTON 73, MASS. LOCKPORT, N. Y.



CONNERY *EXPANSION STIFFENED* CONSTRUCTION

CONNERY CONSTRUCTION CO.

SECOND & LUZERNE STS. PHILADELPHIA

Report Estimates Postwar Utility Construction

Planned outlays for plant and equipment by electric and gas utilities in the first year following V-E Day are figured at $700,000,000 by a U. S. Commerce Dept survey made public recently in the dept's *Survey of Current Business*. The Commerce Dept estimate is $117,500,000 above the figure estimated in July by the Office of War Utilities when OWU's figures are adjusted to cover the same period and the same owners. So adjusted, the OWU figures indicate electric utility construction of $492,500,000 from May, 1945, through April, 1946, with an additional $90,000,000 of gas construction during the same period, for a total of $582,500,000 in electric-and-gas-utility construction.

Noting that utility outlays during the war were made principally by private companies, in contrast to the situation in the manufacturing field where outlays were largely governmental, the report asserted that reduced influence of utilities on capital formation in the year following V-E Day "can be attributed primarily to the increased capacity built during the war." This is held true despite the fact that utilities declined in importance to capital formation before the war. Planned outlays by utilities during the next year "need provide for only a minimum of expansion over recently reduced levels, in contrast to the situation in many non-war manufacturing industries," the report asserted, basing the statement on the expectation that peak utility demands forced by the war are not expected to be equaled in the first year after V-E Day.

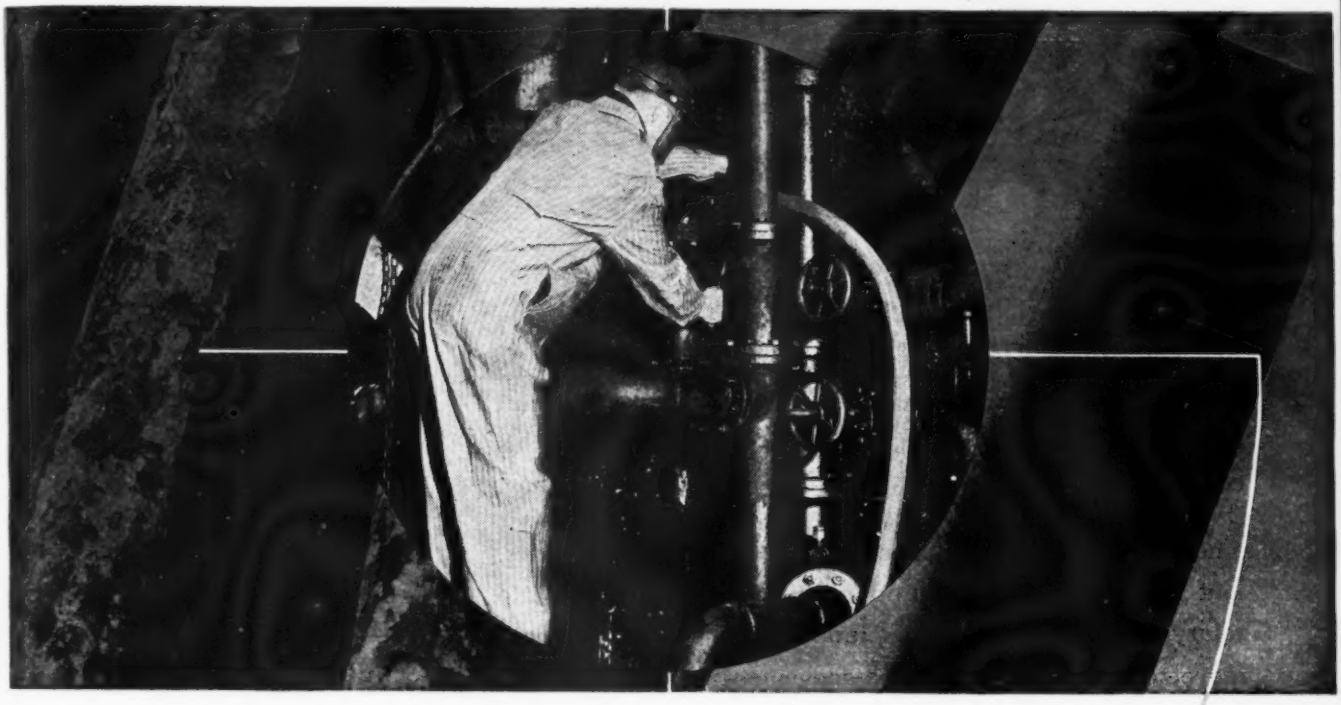
"Despite the comparatively smaller part of capital outlays expected from these fields (rails and utilities) planned expenditures are almost 40% higher than in 1944 and 90% above 1939," declared the report, prepared by D Stevens Wilson for the Bureau of Foreign and Domestic Commerce. "In both instances, however, the projected totals are far below 1929 outlays in contrast to planned expenditures of manufacturers, which . . . were more than half again larger than in 1929." Electric-and-gas-utility outlays for the year after V-E Day are shown to be about two thirds of the peak years of 1929 and 1930 and about the same as in 1941.

"The electric utilities, which account for three fourths of the combined electric and gas total, are planning outlays only 25% above the 1939 level," the report said. "The largest dollar amounts are indicated for the East North Central power region, although proportionately, the South Central regions expect the largest percentage increases . . ."

Installation of a 2300-v generator and a 675-hp diesel engine is in progress now at the plant of National Utilities Corp, Port Alverni, B. C. The utility has ordered this setup to insure its ability to maintain service should the power plant of Bloedel Stewart and Welch's mill, which is now supplementing the utility supply, be compelled to shut down for any reason.

DOWELL

CHEMICAL SCALE REMOVAL SERVICE



A JOB FOR ENGINEERS WHO KNOW YOUR PROBLEM

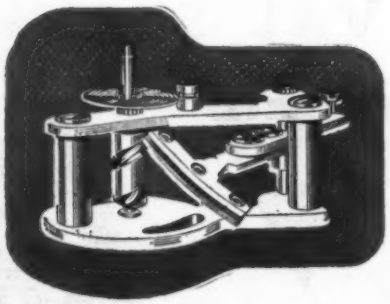
Look at the "before and after" pictures above and note the condition of the open box condenser tubes. This heat exchanger was returned to its original operating efficiency in a few hours because the proper solvent, reaching every part of the equipment, quickly dissolved and disintegrated the insulating deposits. Shut down time was further reduced as it was unnecessary to dismantle and reassemble the unit.

Back of every Dowell chemical treatment is careful study of the equipment, the metals involved and composition of the scale or sludge. Every Dowell engineer possesses knowledge based on years of experience and extensive technical resources.

DOWELL INCORPORATED
Subsidiary of The Dow Chemical Company
Executive Office, Midland, Michigan
GENERAL OFFICE, TULSA 3, OKLAHOMA
New York • Philadelphia • Cleveland • Chicago • St. Louis • Houston
Kansas City • Wichita • Mt. Pleasant, Michigan • Salem, Illinois

Call the nearest Dowell office for information on how to restore your heat transfer equipment to efficient operation. Ask for a free estimate and your free copy of "More Power to America's Industry."

IT'S IN THE GROOVE!



The groove in the roller of the Helicoid movement has a helicoid surface. This surface is hard and polished. The Bakelite cam rides on this surface in continuous, rolling point contact. No metal spur gear teeth can compare with this combination in wear resistance, smoothness and accuracy.

The principle of the helicoid is as old as Archimedes. But its use to translate and multiply linear motion into rotary motion in the same plane is new in the Helicoid movement. And the Helicoid movement is the first new, major improvement in pressure gauges since the Bourdon tube was invented.

Only Certified Pressure Gauges are made with the Helicoid movement. They are guaranteed to test-gauge accuracy. Yet, they will wear longer and remain accurate longer than any other pressure gauge made. They are ideal for engines, locomotives, turbines, tractors, hydraulic presses, pumps, and compressors.

See your nearest Distributor.

Certified GAUGE
AND INSTRUMENT CORP.

[redacted] Certified GAUGE [redacted]

Slide Films Explain Industrial Electronics

New General Electric talking slide-film training course offers a practical and quickly grasped understanding of industrial electronics. Presented in a clear, nontechnical manner, the course consists of 12 talking slide films (35-mm film strips and 16-in. 33⅓-rpm records) each about 30 min in length, 25 copies each of 12 lecture review booklets keyed to the slide films, an instructor's manual covering presentation of all 12 lectures and a carrying case designed to accommodate the complete course. Cost of the course is $100.

The introductory film, *Harnessing the Electron*, illustrates wide range of applications of electronic tubes and their four fundamental uses, while the second film, *Electronic Tubes as Rectifiers*, describes the three important types of rectifiers, the kenotron, phanotron and ignitron. The grid control of electronic tubes is discussed in the third film, and the fourth and fifth cover fundamentals of electricity. Six of the remaining films are devoted to photoelectric and electronic relay systems, electronic rectifier equipment, *Thy-mo-trol* drive, electronic heating in industry and electronic control of ac power, respectively. The final film, *Electronics—Today and Tomorrow*, summarizes present-day application of electronics and discusses the general trend of industrial electronics and its wide possibilities in the postwar world.

Electric Group Discusses Federal Power Projects

Representing a large part of the business-managed electric industry, 167 electric light and power companies made known their position in a joint statement with regard to proposed river developments by the U. S. Government. These developments, providing for creation of Missouri Valley Authority and other projects similar to TVA, as well as completion of several already in operation, entail an estimated initial expenditure in excess of $3,850,000,000.

Specific points made by the electric companies in defining their attitude toward these government undertakings are: (1) Whenever a dam is proposed, all of its purposes should be clearly defined in the legislation—flood control, navigation, irrigation or power. (2) Government-produced power should be sold to existing power systems without special privilege or discrimination, to avoid costly duplication and insure widest use and lowest rates. (3) Any savings thus effected should be passed along to consumers under state or other regulations. (4) Government may properly regulate business, but should not operate business.

Jet propulsion principle dates back to beginning of Christian era. Mechanical idea is 1944 years old. First demonstration of jet reaction was Hero's aeolipile—a hollow sphere which spun by steam escaping from two jets.

2¾% Nickel Steel locomotive rods, one bent cold to show ductility.

QUENCHED AND TEMPERED

NICKEL STEEL

FORGINGS COMBINE

EXCEPTIONAL DUCTILITY WITH HIGH TENSILE STRENGTH

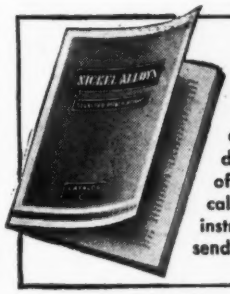
Composition and Typical Properties of Normalized Quenched and Tempered 2¾% Nickel Steel Rods

Description or Size	Melt Yield Pt. No. #s per Sq. In.	Tensile Strength #s per Sq. In.	Elong. % in 2 In.	Reduction in Area %	ANALYSIS					
					Car.	Mang.	Phos.	Sul.	Sil.	NI
Main Rod....	92900	110000	25.0	64.4	.31	.78	.027	.026	.25	2.75
Main Rod....	86500	104500	25.5	65.6	.32	.86	.034	.032	.29	2.69
Main Rod....	86360	104400	26.0	64.8	.32	.86	.034	.032	.29	2.69
Main Rod....	87850	102350	26.0	66.2	.31	.89	.037	.025	.32	2.69
Front Rod....	86000	102250	25.0	67.3	.29	.82	.035	.027	.24	2.71
Front Rod....	83900	104250	25.0	66.1	.29	.82	.035	.027	.24	2.71
Front Rod....	86850	104250	27.0	66.1	.32	.86	.035	.025	.30	2.65
Front Rod....	89500	107050	25.5	65.6	.32	.86	.035	.025	.30	2.65
Back Rod....	89500	107650	25.0	62.7	.30	.79	.030	.025	.22	2.71
Back Rod....	87500	106450	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	87000	105600	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	88150	104850	26.0	66.8	.29	.82	.035	.027	.24	2.71

Specimens Taken from Mid-Section of Prolongations of the Forgings

The above table compiled by the American Locomotive Company shows the chemical compositions and mechanical properties of some normalized, quenched and tempered nickel steel front, main and back rods recently produced as replacement rods for locomotives being speeded up and rebalanced. These values are typical of replacement rod forgings recently tested by that company.

Quenched and tempered nickel steel forgings provide high tensile strength and ductility, combined with unusual toughness and high fatigue strength—qualities which tend to obviate breakage and assure long, trouble-free service when employed in heavy duty machinery and equipment.



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These NEW Catalogs, Booklets and Bulletins Are Yours for the Asking!

ELECTRICAL EQUIPMENT

1 TURBINE GENERATORS — Moore Steam Turbine Div, Worthington Pump & Machinery Corp, Wellsville, N. Y. 46-page bulletin No. 1960 covers models, applications and installations of Worthington turbine generators.

2 ELECTRONIC FUNDAMENTALS — Allis-Chalmers Mfg Co, 568, Milwaukee 1, Wis. 20-page booklet No. E6358, entitled "Introduction to Electronics," provides an understanding of the principles of electronics and the part it will play in future industrial developments.

3 ELECTRICAL PRODUCTS — Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo. 16-page folder No. GU-86 describes entire line of motors, transformers, industrial brakes and controls, hydraulic brakes, air brakes, etc.

4 SYNCHRONOUS GENERATORS — Electric Machinery Mfg. Co, Minneapolis 13, Minn. 4-page folder No. 177 describes 3.75- to 4.38-kva generators and publication No. 179 discusses 250- to 5000-kva generators.

5 ELECTRONIC FACTS — Electronic Corp of America, 45 W 18th St, New York 11, N. Y. 32-page booklet, entitled "The Amazing Electron," gives basic facts about electronics.

6 DEAD-FRONT SWITCHGEAR—Allis-Chalmers Mfg Co, 570 Milwaukee 1, Wis. 4-page bulletin No. B6376 contains detailed information on metal-inclosed dead-front switchgear for low-voltage distribution circuits.

7 ELECTRICAL PRODUCTS — Allis-Chalmers Mfg Co, 565, Milwaukee 1, Wis. 32-page directory of products and engineering literature describes lines of equipment Allis-Chalmers furnishes to nearly every industry.

8 INSTRUMENT PANELS—Panelboard Dept, Falstrom Co, 28 Falstrom Court, Passaic, N. J. 6-page catalog No. 119 illustrates a large number of panel and cubicle installations constructed from Falstrom standard units. It also shows custom-built assemblies manufactured to individual specifications.

9 LAMP LOCKING DEVICE—Laduby Co, 178 Oak St, New Haven 11, Conn. 4-page circular contains catalog numbers, installation drawings and instructions, as well as samples of Flur-O-Locks, locking devices for fluorescent lamps to eliminate danger to employees and machinery from falling lamps.

MAINTENANCE AND SAFETY EQUIPMENT

10 AIR-TOOL ACCESSORIES — Construction Equipment Div, Worthington Pump & Machinery Corp, Holyoke, Mass. 12-page bulletin covers Blue Brute line of accessories for rock drills and air tools.

11 METAL-CUTTING TOOLS—Haynes Stellite Co, Kokomo, Ind. 52-page booklet, entitled "Haynes Stellite Metal-Cutting Tools," describes metal-cutting tools made from Haynes Stellite 98M2 and Star J-Metal alloys.

12 FLASHLIGHT BATTERY — Ideal Commutator Dresser Co, 1286 Park Ave, Sycamore, Ill. Folder gives basic principles and added improvements of Ideal rechargeable flashlight battery.

MAINTENANCE MATERIALS

13 PROTECTIVE COATING — Better Finishes & Coatings, Inc., 268 Doremus Ave, Newark 5, N. J. 16-page booklet describes Liquid Envelope, a peelable plastic film useful for storing equipment.

14 SELF-BONDING FLOOR MATERIAL—Continental Asbestos & Refining Corp, 1 Madison Ave, New York 10, N. Y. Bulletin presents Stonoleum flooring, which can be applied directly over old concrete and practically any other sub floor.

15 OXYGEN USES — Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 24-page booklet No. ADG-2014, entitled "Oxygen—Indispensable Servant of Industry," tells how oxygen is made and how it is used in industry.

16 SYNTHETIC RUBBER—B F Goodrich Co, Akron, Ohio. 8-page catalog section No. 8000 gives properties of Ameripol D, an oil and heat resistant synthetic rubber for specialized applications.

17 ROOF COATING — Alken Murray Corp, 1841 Broadway, New York 23, N. Y. 4-page bulletin describes Alken Endurall for preserving roofs.

18 CORROSION-RESISTANT MATERIALS—U. S. Stoneware Co, Tallmadge Circle, Akron, Ohio. 16-page bulletin No. H discusses some of the corrosion-resistant materials and equipment available now.

19 CONCRETE FLOOR — Universal Atlas Cement Co, Chrysler Bldg, New York, N. Y. 24-page booklet tells about advantages of better illumination and gives pertinent data on value, construction and maintenance of light-reflecting floors built with white cement.

20 DRAIN CLEANER—Alken Murray Corp, 1841 Broadway, New York 23, N. Y. 4-page folder presents Kleenpipe for congestion in drain pipes, wash basins and other waste lines.

METALS AND ALLOYS

21 MAGNESIUM ALLOYS — Magnesium Div, Dow Chemical Co, Midland, Mich. 20-page booklet answers questions most frequently asked about magnesium and Dowmetal. 16-page booklet consists of text and tables on Dowmetal magnesium alloys.

22 ALUMINUM BRONZE — Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 28-page bulletin No. 71 covers products, facilities and abilities of the Ampco organization. 20-page bulletin No. 64A discusses products of new Ampco extrusion mill, such as extruded bronze bars, tubes and shapes of certain grades of Ampco metal, Ampcoloy bronze alloys and Ampco rolled sheet.

(*Continued on page* 190)

HOW TO ORDER

Be sure to fill out, completely one coupon for each piece of literature you order. (See sample below.) This gives your request authority and helps the manufacturer to address your copy completely. Readers who fail to prepare request blanks correctly may be disappointed under difficult postal conditions and limited quantities of bulletins available today.

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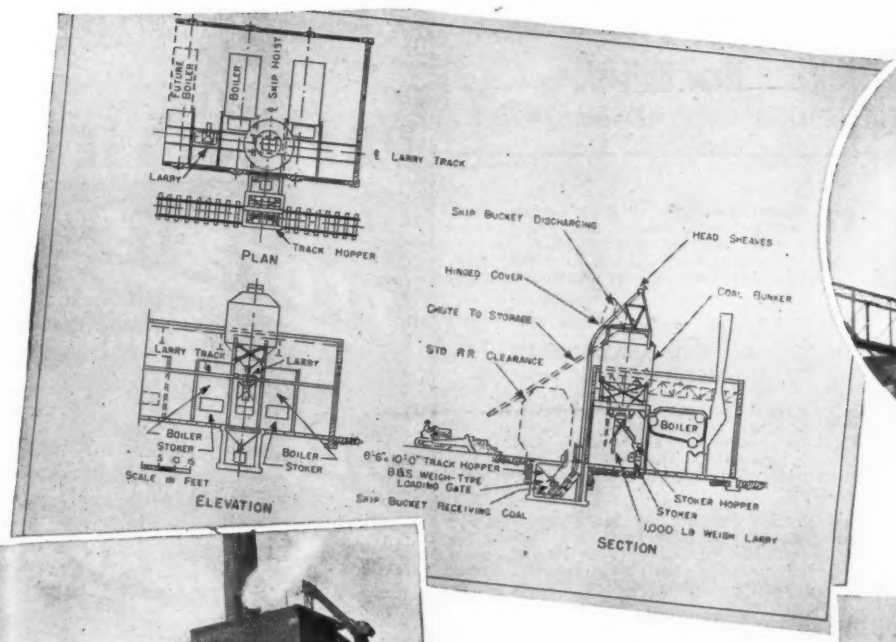

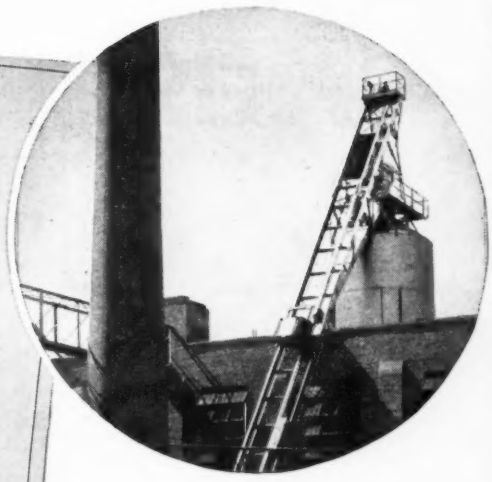

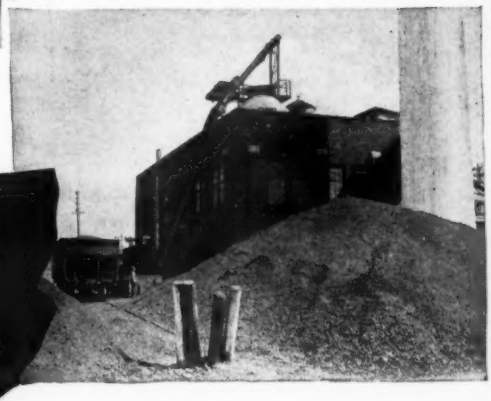

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New Bulletins

(*Continued from page* 188)

23 **MANGANESE STEEL** — American Manganese Steel Div, American Brake Shoe Co, Chicago Heights, Ill. 32-page bulletin No. 1144-NM gives nonmagnetic applications for Amsco manganese steel.

METERS AND INSTRUMENTS, MECHANICAL

24 **FLOW-RATE MEASUREMENT** — Fischer & Porter Co, Hatboro, Pa. Catalog sections 10-C, 43-E and 98-Y provide complete information about the Rotameter for flow-rate measurement and control.

25 **OPEN-CHANNEL METERS**—Bailey Meter Co, Cleveland 10, Ohio. 12-page bulletin No. 62 features Bailey open-channel meters for sewage industrial waste, sludge and irrigation water.

26 **TRACTION DYNAMOMETER** — W C Dillon & Co, 5410 W Harrison St, Chicago 44, Ill. 20-page manual gives story of traction dynamometer and the constantly increasing number of uses that are being found for it in simplifying testing and weighing procedures.

27 **ROTAMETER NOMOGRAPH** — Fischer & Porter Co, 960-S County Line Rd, Hatboro, Pa. Nomograph for determining correct Rotameter size for steam measurement is an invaluable guide to Rotameter selection.

PIPING, FITTINGS, VALVES AND SPECIALTIES

28 **PIPE COUPLINGS** — Drinkwater, Inc, 2323 S Michigan Ave, Chicago 16, Ill. 4-page bulletin describes new line of pipe couplings, known as Presto-Lock flexible pipe couplings.

29 **SNOW-MELTING SYSTEM**—A M Byers Co, Pittsburgh, Pa. 6-page leaflet, Case Study No. 4, discusses snow melting by underground hot water or steam wrought-iron pipelines.

30 **HIGH-PRESSURE VALVES**—Ludeman Valve Div, Skinner Engine Co, 420 Lexington Ave, New York 17, N. Y. 16-page bulletin No. 5 discusses Ludeman DU-AL high pressure valves.

31 **VALVES** — Wm Powell Co, 2503 Spring Grove Ave, Cincinnati 22, Ohio. 20-page booklet covers selection, design, construction, application and care of valves.

PUMPS

32 **ROTARY PUMPS**—Blackmer Pump Co, Grand Rapids 9, Mich. Folder No. PS-1 describes several Blackmer rotary pumps.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **HYDRAULIC PUMPING** — Kobe, Inc, Huntington Park, Calif. Service manual gives complete directions for maintenance of Kobe Triplex pumps and power units. Manual is only distributed to persons concerned with hydraulic pumping operations.

33 **SEALS AND RINGS** — Morganite Brush Co, Long Island City 1, N. Y. 6-page folder discusses Morganite seals and rings for liquid and gas pumps, compressors, torque convertors, meters, etc.

34 **PUMPS**—Deming Co, Salem, Ohio. 32-page booklet, entitled "Deming Pumps Everywhere," shows the progress of Deming Co in pump manufacturing.

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PROTECTS! AGAINST FIRE OR EXPLOSION

SEALS! AGAINST LOSS BY EVAPORATION

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Super-safe and super-convenient with top quality rugged construction. Flexible spout puts liquid where you want it, in a trickle or a full stream, without spilling a drop. The modern, fire-safe, wasteless way to dispense gasoline, naphtha, solvents, and other dangerous fluids. Made in 3-gal. and 5-gal. sizes. Underwriters' approval. *Write for literature.*

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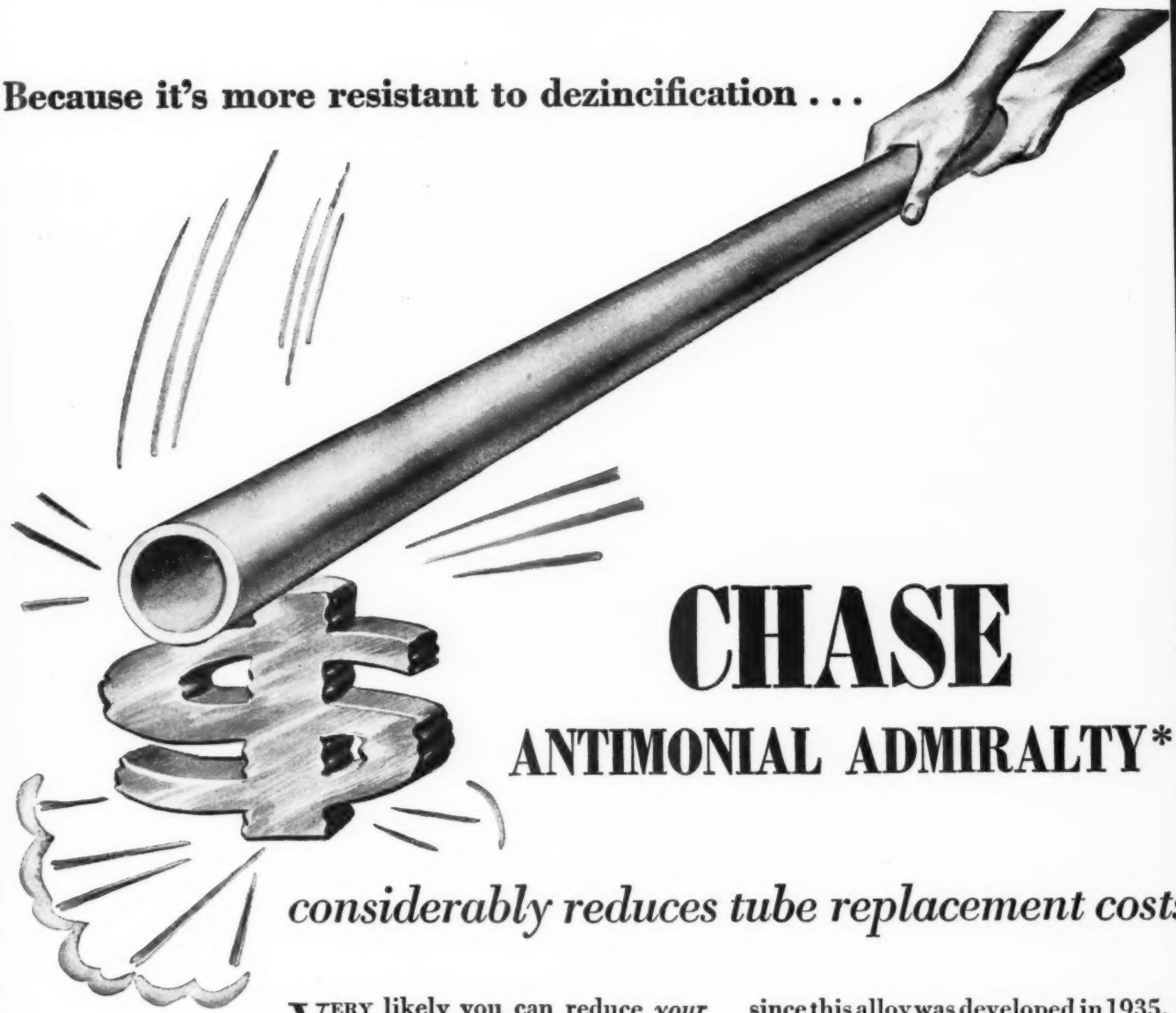
Because it's more resistant to dezincification . . .



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ANTIMONIAL ADMIRALTY*

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VERY likely you can reduce *your* annual tube replacement costs with condenser tubes of Antimonial Admiralty. This patented Chase copper alloy is extraordinarily resistant to dezincification. Yet it costs no more than plain Admiralty.

Millions of pounds of Chase Antimonial Admiralty have been installed since this alloy was developed in 1935, and not a single service failure has been reported from dezincification. Power engineers can readily appreciate what this longer tube life means in terms of replacement savings.

For full details phone your nearest Chase Warehouse or Service Office, listed below.

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This is the Chase Network—handiest way to buy brass

THE HEART OF A DART

is the True Ball Joint of its Two Bronze Seats

Bronze-to-bronze seats, ground to form a true ball joint, distinguish the Dart Union from all others. Tight coupling is attained without a jam-joint; thus Darts may be taken down readily, and used over and over again. Pipe ends and nut are made from high-test, air-refined malleable castings; have high tensile strength and yield point; are practically indestructible. In length of trouble-free service, Darts are easily the most economical unions. Your supplier will be glad to demonstrate Darts' superiority.

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WELDING

35 WELDING POSITIONER — Standard Machinery Co, Providence 7, R. I. 4-page catalog presents a welding positioner that provides easy and positive control of rotation elevation and tilting of work up to 700 lb.

36 WELDING TECHNIQUE — Ampco Metal, Inc, Milwaukee 4, Wis. 20-page bulletin describes methods of welding with Ampco-Trode coated aluminum-bronze weldrod.

37 WELDING SYMBOLS — Hobart Bros, DM-665, Troy, Ohio. Chart gives basic characters of symbol writing for arc welding.

OTHER EQUIPMENT

38 CAST-IRON RADIATION — D J Murray Mfg Co, Wausau, Wis. 4-page folder No. CIR-345 covers design, dimension and rating of Grid fin radiation. 12-page leaflet No. CI-445 presents advantages of Grid unit heaters.

39 COMBUSTION EQUIPMENT—Fairmont Coal Bureau, 122 E 42nd St, New York 17, N. Y. 16-page publication, entitled "Fuel Economics Affecting Power Plant Design," consists of a panel discussion on the subject that will be of value in achieving sound economic fuel planning for the future.

40 COMPRESSORS — Worthington Pump & Machinery Corp, Harrison, N. J. Bulletins No. H-850-B65A-455MP, C-1100-B21, C-100-B22, C-1100-B23 and C-1100-B27 discuss Worthington compressors and evaporative coolers.

41 COMPRESSORS — Dresser Industries, Inc, Terminal Tower, Cleveland 13, Ohio. 12-page folder gives member companies of Dresser Industries and products manufactured, such as compressors, engines, pumps, meters, gas generators, etc. Also, folder tells how group of companies operate.

42 FEEDWATER REGULATORS — Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio. 8-page bulletin No. 83-C, entitled "Bailey Thermo-Hydraulic Feed Water Regulators," describes improved designs of thermo-hydraulic generators and bellows-operated feedwater regulator valves, suitable for feed lines ranging in size from ¾ to 6 in.

43 PRESSURE REGULATOR—Hagan Corp, Hagan Bldg, Pittsburgh, Pa. 4-page bulletin No. 1145 covers operation and characteristics of Type SO regulator for control of suction, pressure or flow in any gas- or air-flow system.

44 HEAT EXCHANGER—Brownell Co, 422 N Findlay St, Dayton 1, Ohio. 4-page bulletin No. H-1 (Fifth Edition) discusses instantaneous and storage hot-water generators, closed heat exchangers and converters, open heat exchangers.

45 COOLING-SYSTEM PROBLEMS—D W Haering & Co, Chicago, Ill. Pamphlet presents an interesting study of correction of cooling system problems. It describes the correction of an accelerated corrosion problem on the water side of process equipment used in manufacture of synthetic dyestuffs.

46 SHEAVES—B. F. Goodrich Co, Akron, Ohio. 4-page catalog section No. 2185 gives data on sizes, prices and weights of stock cast-iron single- and double-groove FHP sheaves.

47 CENTRIFUGAL CLUTCHES—Automatic Clutch Corp of Canada, 388 Yonge St, Toronto, Canada. 12-page booklet presents construction, operation and application of BLM centrifugal clutches.

48 NOZZLE TESTER—Buda Co, Harvey, Ill. 8-page bulletin No. 1170 gives features of Buda nozzle tester and instructions for diesel nozzle testing.

49 WATER TREATMENT—Alken Murray Corp, 1841 Broadway, New York 23, N. Y. Five bulletins describe Soot-Off, Scaloff, Even-Flo, Aquakleen and other Alken water treatment.

50 VIBRATION CONTROL — Korfund Co, 48-15 32nd Pl, Long Island City 1, N. Y. 12-page bulletin, entitled "Vibration in Industry," explains methods of controlling vibration.

EXTREMELY ACCURATE REGULATION

. . . Extremely Compact in Size!

A fraction turn of the handwheel—and you can control *exactly* the pressure of steam passing through this very compact K & M Reducing Valve. Model 481 is widely used for difficult reduction service in industrial processes—and as a primary valve in double reduction installations. Self-contained . . . made in bronze . . . available in valve sizes of ½″ to 2″—with 5⅜″ the maximum overall measurement, face to face! Yet it accurately controls inlet pressures up to 250 lbs. . . . maintaining constant reduced pressures of 2 lbs. to 80% of the inlet. If you have a tough pressure reduction problem, perhaps K & M #481 is the answer. Our Engineering Department invites your inquiries.

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Assure Accuracy, Positive Operation and Long Life

Mercoid hermetically sealed mercury switches are the most dependable means for opening and closing an electrical circuit. They cannot be affected by dust, dirt, moisture or corrosion; nor are they subject to open arcing, pitting, oxidation or sticking of contacts.

Mercoid Switches are successfully used in many industrial applications.

There are various types available. The magnetic type, illustrated above, operates with the movement of the magnet—the tube remains stationary. The tilting type, opens and closes the circuit on a snap-action principle. Both types provide an instantaneous and positive "make" and "break" in the circuit.

Our engineering staff will assist in their application to any of your switch problems.

Further information sent upon request.

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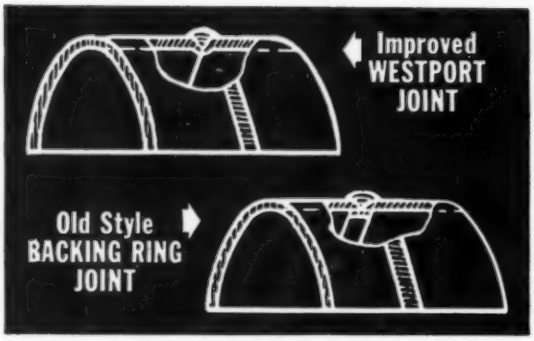
THE WESTPORT WELDED JOINT

MEETS A.S.M.E. CODE REQUIREMENTS



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Here's the advantage of the Westport Joint: (1) Greater flexibility in alignment of pipe, valves and fittings (2) Complete penetration to the root of the weld (3) No constriction in pipe area due to Backing Rings. (4) No sacrifice in strength of pipe due to the removal of the wall or Backing Ring (5) Smooth pipe contour at base of weld, with no "icicles" or protrusions. With so many advantages, Westport offers pipe savings.

ENGINEERS' NOTE:

Do you have any piping problems we might be able to help solve? All types of prefabricated piping jobs are today being done by W. K. Mitchell Co. Years of piping research and experience has taught us the solution to piping troubles. If we can be of help, please call on us. Our Engineers are always at your service.

WRITE FOR LATEST DATA

1899 1945

W. K. MITCHELL & CO., INC. Philadelphia 46, Pa.

Power News

(*Continued from page* 134)

'Wartime' Legislation Saves Coal and Oil

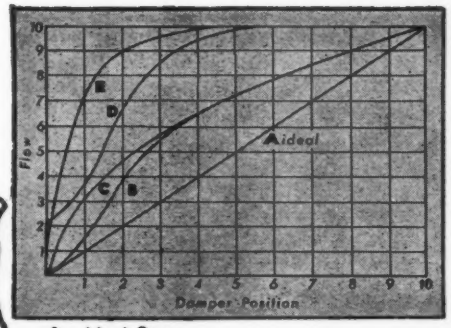
War Production Board Chairman J A Krug told Congressional leaders that it is no longer vital to retain legislation on Wartime for purpose of economizing in power capacity. Krug sent the letter to Senate President Kenneth McKellar, Tennessee Democrat, House Speaker Sam Rayburn, Texas Democrat, Chairman Clarence Lea, California Democrat, of the House Interstate and Foreign Commerce Committee, and Chairman Burton K Wheeler, Montana Democrat, of Senate Interstate Commerce Committee. Meanwhile, Representative Clarence Cannon introduced a bill to end Wartime in December. In his letter, Krug declared that this decision is one for Congress to make.

With the advent of European victory, it has been possible for the Office of War Utilities to authorize construction of more than 2,000,000 kw of generating capacity and relax many previous controls. Wartime saved installation of 1,500,000 kw when materials were short, Krug pointed out. He said it appears that the peak war production demands for electric power have passed. However, coal savings made possible by this measure are more important than ever before. "In the first six months, production was short of requirements and requirements are still in excess of supply." Wartime saved about 900,000 tons of coal and 880,000 barrels of oil.

"Therefore, even though Wartime will not be needed as a power measure, we strongly urge its retention until at least the spring of 1946 because of the significant savings in coal and fuel oil which it makes possible."

Termination of war contracts held by General Electric Co, while proceeding at a substantial rate, has left few gaps in the company's over-all business because of the large volume of new orders that have been received. At the same time, some relief in a tight labor situation has been afforded. In 1944, GE war contracts were terminated by cancellations or cutbacks at an average rate of $32,000,000 a month. In first five months of 1945 monthly average of terminations has been only $23,000,000, with March and May up to last year's average and the other three months substantially below it. Orders received in 1944, largely for war products, totaled $1,609,636,000, whereas orders for first five months of 1945 totaled $598,481,000. In each period, the new orders have exceeded the billing for the period.

Ansul Chemical Co is building a new structure for its Dugas div. The building will house manufacturing operations for Dugas fire extinguishers and is expected to be completed soon.



A Ideal Curve
B Heacon damper with V-ports
C Heacon damper without V-ports
D-E Typical damper curve

DO YOUR DAMPERS MEET THESE SPECS?

TYPICAL SPECIFICATIONS

SECONDARY AIR-DUCT DAMPER—The flow of secondary air to the burners shall pass through a duct 30" high and 40" wide outside. This duct shall be equipped with a damper to completely control the flow therein from zero to maximum. The companion angles, gaskets and bolts for mounting the damper shall be furnished by the damper contractor. The damper design shall be suitable for 600°F. air and 9" w.c. static differential.

The damper shall function to regulate the flow of secondary air and shall move from closed to open in 30 seconds. It shall have a smooth-flow characteristic curve, free from critical points. Provision shall be made for accurately incrementing the small flows as the damper approaches the closed position. The purchaser may require a flow characteristic curve to be submitted for approval, and reserves the right to reject any damper with an unsatisfactory curve.

Ample operating clearance shall be provided for the moving parts as well as ample provision for expansion without introducing leakage. Operating shafts shall be mounted in ball bearings especially designed for the service and fitted with dust seals. The static pressure at the damper shall not be reflected as torque in the operating shaft.

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1. MORE RELIABLE OPERATION
2. INCREASED CAPACITY
3. REDUCED MAINTENANCE
4. GREATER FLEXIBILITY
5. HIGHER EFFICIENCY
6. BETTER REGULATION
7. LOWER BANKING LOSSES
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10. CLEARANCE WITHOUT LEAKAGE

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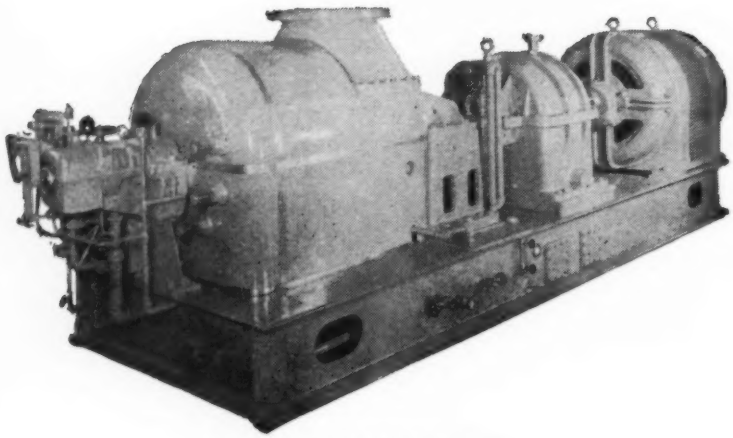
MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycles alternating current on steam at 285# gauge, 700 degrees F., an exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

MURRAY *also produces:*

Mechanical drive turbines, horizontal and vertical

Reduction Gears **Steam Boilers**

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

Postwar Plan Calls for Electrical Modernization

Long-range plan calling for unified action by electric power companies, machinery manufacturers and electrical manufacturers has been designed to accelerate the mechanization and electrification of American industry and farming in the postwar era. Labeled the *More Power to America* program, the plan comprises many months of field research, investigation and analysis by General Electric industrial engineers and cooperation by representatives of other industries.

The major benefits from such a modernization plan, according to Charles E Wilson, president of GE, are three in number: (1) Put into action widely, the program will facilitate reconversion of industry on a soundly engineered basis, to insure costs that will enable businesses to compete successfully in domestic and export markets. It will improve peacetime industrial operations and American standard of living by increasing earnings and productive ability of workers. It will help maintain the U. S. as a potential military and naval power by strengthening productive capacity. The *More Power to America* plan is thought of by GE in terms of five, ten or, perhaps, even 20 years. It has resulted from more than two years of coordinated effort by application engineers; product, industry and utility specialists; and market analysts.

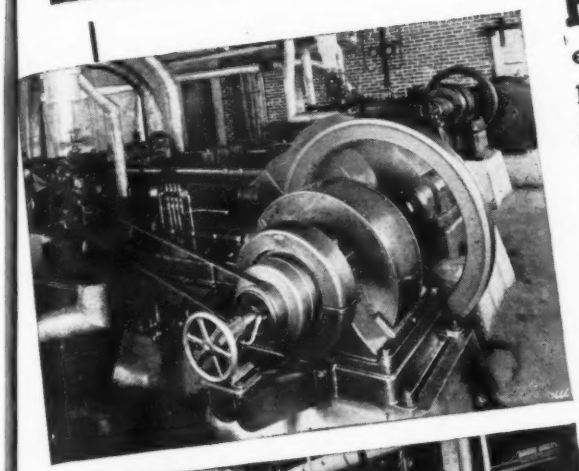
Seventeen professional and technical societies of the Kansas City area joined forces in establishing the Technical Societies Council for unified action in matters pertaining to development of scientific endeavors. At the organization dinner-meeting held in Kansas City recently, Dr W M Hoehn, member of American Chemical Society and laboratory director of George A Breon & Co, was elected chairman; C M Lytle, member of Missouri Society of Professional Engineers, with the Kansas City Power & Light Co, vice-chairman; and Charles Briggs, member of the American Society of Mechanical Engineers, with the Burns & McDonnell Engrg Co, secretary-treasurer.

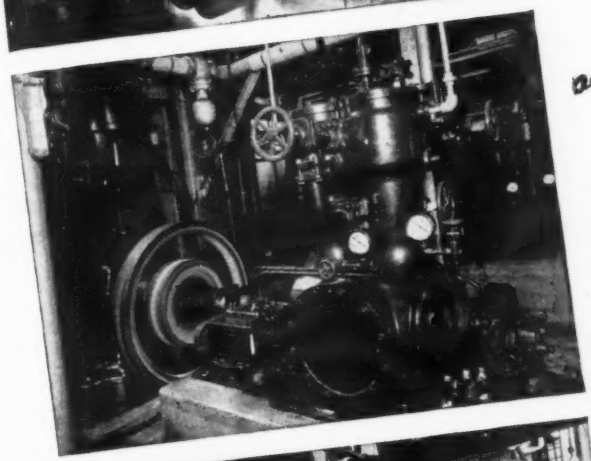
Office of War Utilities has approved, without rating, installation of three 25,000-kw hydroelectric turbine-generators at Keswick dam, downstream from the Reclamation Bureau's Shasta Dam in the mountains of California's Central Valley. Keswick, purely a power dam, was started in 1941 and was halted late in 1942, after which a small amount of work was permitted to prevent deterioration. Powerhouse structure is about finished. Units averaged about 35% complete when they were halted.

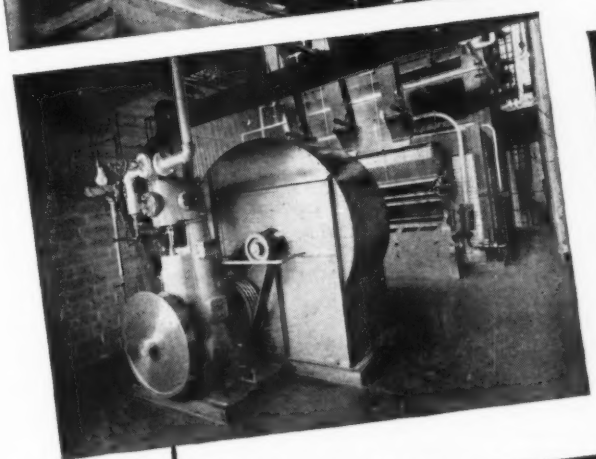
Carbon Light Outshines Sun. An artificial light has greater intrinsic brilliancy than the sun produces. Crater of the positive carbon in a carbon arc light, similar to those used for motion picture projection screens, generates the most intense light known.

Experts Advise:-

"Extract By-Product Power From Steam"







FUEL and power experts seeking ways for reducing cost of steam generated for processing purposes are advising that wherever possible inherent power in the steam be extracted and used. One of the simplest and surest ways of utilizing By-Product Power is to use it to drive a Troy-Engberg Steam Engine. After the power has been used, steam is exhausted from the engine and passed on to the task for which it was generated.

The power thus converted can be used in two ways:

1. As a direct drive for stokers, compressors, fans, and other equipment

or 2. To drive an efficient Troy-Engberg generator, either AC or DC, to supply current for whatever purpose it is desired.

On such applications Troy-Engberg Steam Engines pay for themselves in a surprisingly short time — often in less than a year.

In your planning for post-war economies, don't overlook the possibilities of By-Product Power.

Send for *Bulletin No. 306*

TROY ENGINE & MACHINE CO.

ESTABLISHED 1870

2506 RAILROAD AVENUE, TROY, PENNSYLVANIA

Still available!
MAGNOLIA ANTI-FRICTION BEARING METAL
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In the last two years many bearing metals have disappeared from the market. But MAGNOLIA ANTI-FRICTION METAL is still available.
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The next time bearings need relining, why not use this well known, widely accepted metal? Your local distributor carries MAGNOLIA ANTI-FRICTION METAL in stock for immediate delivery.
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MAGNOLIA BEARING METALS

John J. Hoppes Dies— Business, Civic Leader

Civic leader, manufacturer, inventor and engineer, John J Hoppes, 87, died in Springfield, Ohio, on July 12. From its founding in 1882 until his death, Mr Hoppes was president of Hoppes Mfg Co. He was also first president of Everwear Mfg Co.

Born on an Ohio farm, and educated in the common schools, Mr Hoppes developed an early interest in mechanics, later evidenced by his invention of the Hoppes feedwater purifier, Hoppes deaerating heater, Hoppes V-notch meter and numerous other power-plant devices.

Mr Hoppes was a key figure in setting up the City Commission Government in Springfield. Back in the eighties, he promoted the installation of a city water works and paving of downtown streets. He helped organize the Chamber of Commerce after being president of the Board of Trade and Commercial Club. With P E Montanus, Mr Hoppes organized the Springfield Manufacturers Club. He was a member of the Ohio Engrg Society, National Assn of Power Engineers and American Society of Mechanical Engineers.

Dugas Div, Ansul Chemical Co announces that its line of wheeled fire extinguishers has been given a higher rating as a result of the new dual-stream nozzle. The improved ratings were established by the Factory Mutual Laboratories after observing extensive large-scale fire tests conducted at the Dugas test grounds. Based on open-tank fires of gasoline, the new ratings are five times higher for the small model and ten times higher for the large model.

To meet the anticipated postwar increase in small motors for electrical appliances and in ballasts for fluorescent lamps, General Electric has selected a site at Tiffin, Ohio, and is in process of selecting a site for another manufacturing plant, both to be operated under management of company's Fort Wayne works. M E Lord, manager of the local plant, said buildings will be designed, equipment ordered and construction started as quickly as possible.

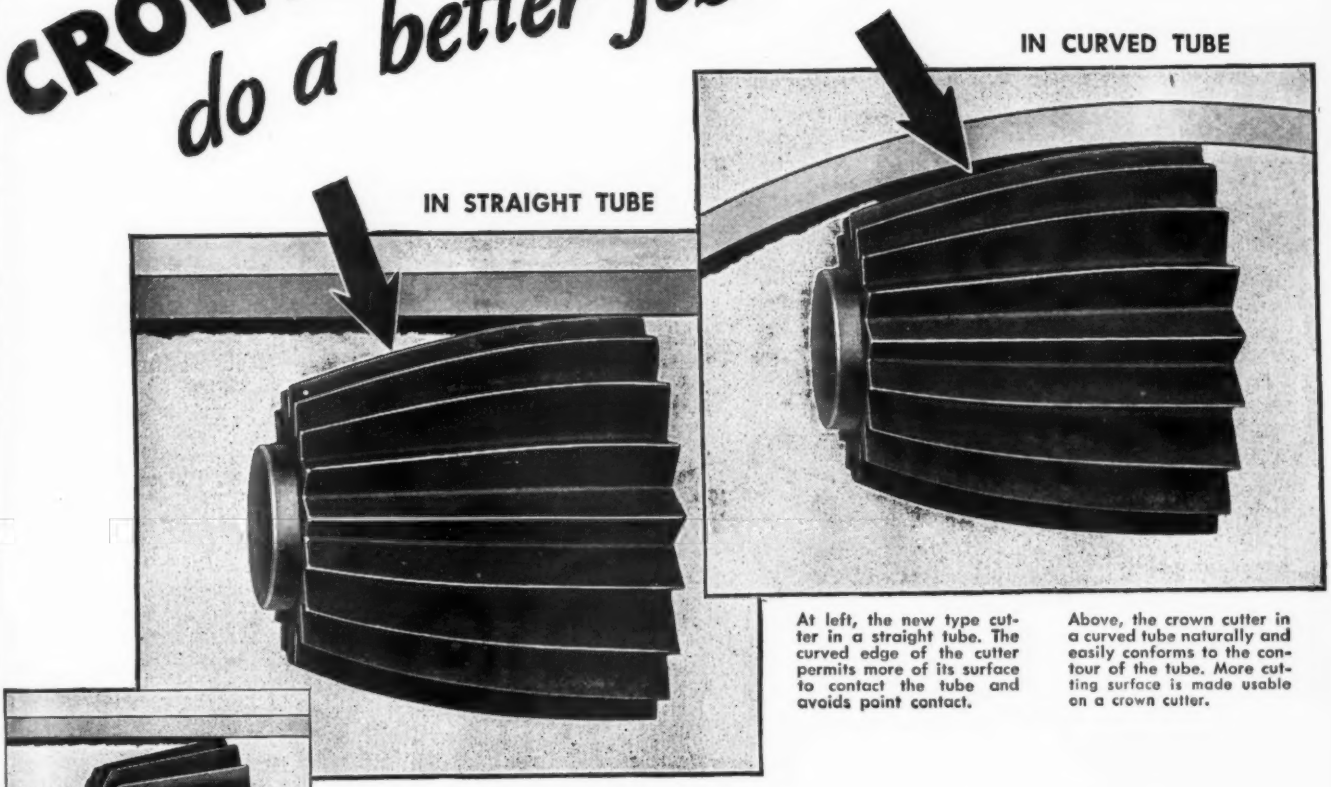
The city council, Chisholm, Minn., has granted a franchise to install a steam and electric plant, with underground distribution lines, to make available live steam and electricity to every home and building in the city. The postwar project will abate the smoke nuisance, assuring a cleaner, more healthful community, save as much as 25% in fuel consumption, and permit new homes to be constructed at a greatly decreased cost because neither furnace nor cellar will be required.

New list of all American Standards and War Standards approved to date has been published by the American Standards Assn and is available free of charge. There are about 800 standards listed in the booklet, covering specifications for materials, methods of tests, dimensions, definitions of technical terms, procedures, etc, in the electrical, mechanical, building, transportation,

CROWN CUTTERS *do a better job*

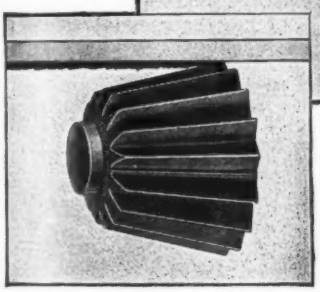
IN CURVED TUBE

IN STRAIGHT TUBE



At left, the new type cutter in a straight tube. The curved edge of the cutter permits more of its surface to contact the tube and avoids point contact.

Above, the crown cutter in a curved tube naturally and easily conforms to the contour of the tube. More cutting surface is made usable on a crown cutter.

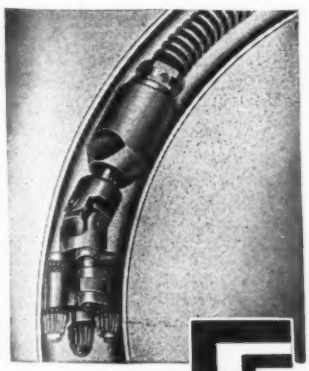


WITH FORMER DESIGN the sharp edge at the rear of the cutter was the only part to meet the tube wall.

Improved cutter design for

ELLIOTT *Lagonda Type* TUBE CLEANERS

Rounding the teeth of front cutters removes all possibility of sharp corners scoring tubes, particularly in curved tubes. This cutter is now standard in all Elliott cutter heads using a 1 in. or larger cutter. Except for the rounded center section, the cutter is the same in dimension as the straight sided cutter formerly used, and will be supplied on orders for cutter replacements.



"TRACKLESS", TOO—cutter teeth are so spaced as to avoid striking the same point in repeated rotation inside the tube. At each revolution a tooth attacks a point slightly in advance of the former point, removing all deposit and preventing gear design in the tube. Another safeguard protecting tube inner surfaces.

For up-to-the-minute developments in tube cleaning, come to Tube Cleaning Headquarters. Elliott Tube Cleaner Bulletin on request.

ELLIOTT *Company*

Lagonda Division • SPRINGFIELD, O.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
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DISTRICT OFFICES IN PRINCIPAL CITIES

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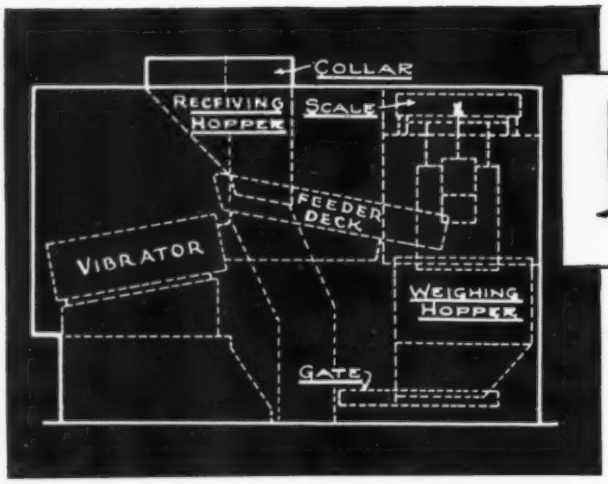

Pat. applied for.

Features:

- No rotating parts
- High weighing accuracy
- Dustproof cabinet
- Quiet operation
- Long life
- Handles wet material

WET COAL can't stick to the Beaumont "Vibro" Automatic Weighing Scale Feeder.

No rotating parts in the Beaumont Scale to which wet coal can stick. Simplified design ensures accurate—automatic—weighing of coal, and similar materials. Feeder capacity adjustable. Units made for feeding materials at from 1 to 60 tons per hour. Request descriptive bulletin.

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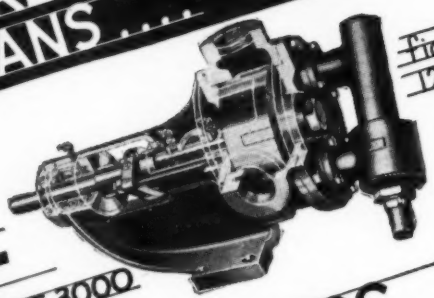
for YOUR FUTURE PUMP PLANS....



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on HEAVY DUTY PUMPS FOR HANDLING LIGHT OR HEAVY LIQUIDS

200 LBS. P.S.I. IN CAPACITIES OF 10-18-35-50-90-200-300 G.P.M.

VIKING PUMP COMPANY

CEDAR FALLS, IOWA

textile and other fields. For ready reference, the standards are listed alphabetically as well as by engineering fields. There is also a separate list of the War Standards—jobs carried through since Pearl Harbor at request of Army, Navy or industrial groups. For a free booklet write to American Standards Assn, 70 E 45th St, New York 17, N. Y.

Compilation of the 8th edition of the National Research Council directory, *Industrial Research Laboratories in the United States,* is under way now. The 7th edition appeared in 1940 on industrial research laboratories of 2264 companies and their subsidiaries. The term *research* for the purpose of the directory is construed as including investigation for improvement of products or reduction of cost of manufacture as well as fundamental research and applied research. It does not apply to laboratories concerned only with commercial testing. If you haven't received a questionnaire for free inclusion of your laboratory in the directory, one will be sent upon request to the Library, National Research Council, 2101 Constitution Ave, Washington 25, D. C.

To assist in higher education and fundamental research work in scientific and industrial fields, a fund of $400,000 has been set aside by the directors of General Electric Co to be known as the Gerard Swope Foundation. Mr. Swope served as president, of GE from 1922 through 1939. He returned to head the company in 1942-44 when C E Wilson, now president, was acting as executive vice-chairman of the War Production Board. Mr Swope also served as director for more than 22 years. Applicants for loans, scholarships and fellowships will be considered not only from the standpoint of academic attainment and financial needs, but also as to character and personal qualifications. Grants will be made without regard to sex, color, creed or national origin.

Electric power system supplying Manila was almost totally destroyed by the Japanese early this year when American troops wrested the city from Jap control, Senator, Millard Tydings, Maryland democrat, told the Senate recently. Prewar Manila had installations capable of supplying 45,000 kw. In June and July, even after Army repairs to the system, there were only 5400 kw available. Even this power was being supplied, in part, by portable generators located chiefly in Army installations. They hoped to increase the power to 15,000 kw in August. It is planned to have one half the lost electrical energy restored to Manila this month. It will take until the first of next year to have the system back to prewar capacity.

German hydroelectric power is being funneled into France through Strasbourg and soon may be used to rehabilitate industrial areas in the Saar region and in Holland and Belgium. Lt Col Leonard T Scully, chief of the military government economics branch, said use of German power was in keeping with a plan to decentralize German

Are they taking too BIG a SLICE?

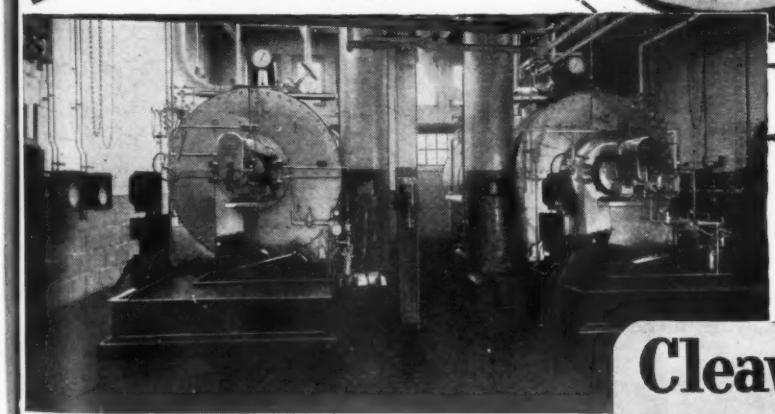
ARE fuel and steam costs demanding too much of the total cost of your product? Then it's time to replace your old, fuel and heat-wasting "boiler" with a modern, efficient Cleaver-Brooks Steam Generator.

Quick steaming and operating at a flat high efficiency of 80% with full or fluctuating loads, a Cleaver-Brooks Steam Generator is thrifty with fuel at all times. Since it need not be "banked" during no-load periods it saves this expense. Its low operating and maintenance costs, through the years, are well established facts to many owners of Cleaver-Brooks steam generators.

It will pay you to investigate — write for complete information.

CLEAVER-BROOKS COMPANY
5109 N. 33rd St. Milwaukee 9, Wisconsin

WRITE ON YOUR BUSINESS LETTERHEAD for the Free Steam Cost-Calculator—a ready-reference slide rule showing the comparative steam costs when using oil or coal as fuel.



WHY NOT HAVE A STEAM PLANT WITH ALL THESE ADVANTAGES?

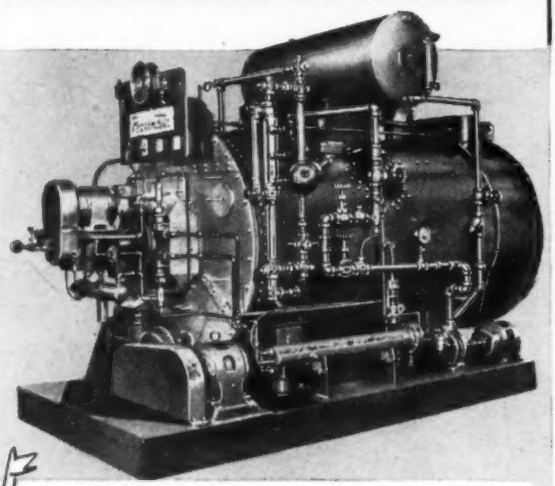
Cleaver-Brooks
STEAM GENERATORS

- A steam plant tailored for your job. Cleaver-Brooks analyzes your load conditions, space and equipment arrangements, future growth needs, puts unit into initial operation, instructs as to operation, care and maintenance.
- Designed for utmost convenience of operator—all controls may be operated from front of boiler. A factory engineer puts unit into initial operation, and trains your employees in operation, care and maintenance.
- One source and one responsibility for the complete generator—Cleaver-Brooks factory-finished and tested—a fully "packaged" unit meeting all code requirements.
- Fast installation. No special foundation needed. Within 24 hours after arrival, your Cleaver-Brooks Steam Generator can be in operation.
- No smoke-stack required; simple roof-high vent exhausts combustion gases.
- Saves space, uses less plant area, fits into low head-room locations.
- Oil-firing eliminates smoke, ashes, clinkers, messy boiler-room conditions.
- Low operating costs; unsurpassed guarantee: — 80% thermal efficiency; 13% CO^2 gases; stack temperature not to exceed 125° F above saturated steam temperature.
- Quick steaming—for any emergency or fluctuating loads — through high heat transfer with Cleaver-Brooks 4-pass down-draft construction and integral oil-burner.
- Full size range is available—22 models in sizes from 15 to 500 hp., at steam pressures from 15 to 200 lbs. p.s.i. Write for bulletin and complete information.

Replace Your Old Boiler With a Ready-To-Use

Powermaster

STEAM GENERATING UNIT



Here's Why the O & S Powermaster gives you top performance . . . . .

1 COMPLETELY "PACKAGED" UNIT with oil burner, all controls and condensate return system *built in* — ready to use when delivered.

2 SPEEDY STEAM PRODUCTION — designed to deliver full pressure from cold water in 18 minutes or less.

3 HIGH OVERALL EFFICIENCY with low-cost operation assured by new simplified O & S design.

4 INTEGRAL OIL BURNER, specially designed for Powermaster, produces a "spinning flame" for complete combustion and highest thermal efficiency.

5 FULLY WIRED AND MOUNTED — no smoke stack or foundation work needed — compact, space-saving, easy to clean.

GET Powermaster Bulletin No. 1213 for full information—write to Orr & Sembower, Inc., 974 Morgantown Rd., Reading, Pa

ORR & SEMBOWER INC.

READING O&S PENNA.

Builders of Better Boilers Since 1885

industry. Plants have been planned at Kembs, in addition to Strasbourg, to feed the Saar district. Another, planned at Aachen, would have a line to Liege, Belgium, and a third may be built at Nijmegen, Holland.

In an unusual job of maintaining war schedules, the Rust Engrg Co will replace a boilerhouse and boilers of the Chesapeake & Ohio Railway Co without interrupting railway operation. Four of six old boilers will be removed, while the remaining two continue to furnish power. Half of the building will be torn down and replaced by a new structure. Two new boilers will be installed and steam generated to take over the power-supply job. In the second stage, the remaining two boilers and remaining section of the old building will be removed and replaced by a new structure and two new boilers. The four new boilers will represent more steam-generating capacity than did the six removed. Contract for this work is in excess of $600,000.

New 72-page catalog of publications and patents which have resulted from 15 years of fundamental and applied Battelle research includes subjects in fields of organic chemistry, electrochemistry, chemical engineering, graphic arts, welding technology, applied mechanics, mineral dressing, industrial physics, ceramics, fuels and metallurgy. Write to Battelle Memorial Institute, Columbus, Ohio, on university or company letterhead for free copy.

American Society of Heating and Ventilating Engineers establishes the John R Allen Memorial Library. This library of books, pamphlets and other printed matter on heating, ventilating and air conditioning will be located in the society's research laboratory. Authors of books are invited to contribute gift copies and members and friends of the society are urged to send any printed material of historical value. All contributions should be sent parcel post or express collect to Director of Research, ASHVE Research Laboratory, 10700 Euclid Ave, Cleveland 6, Ohio.

Three new specialized courses in arc welding are under the supervision and direction of Arthur Madson, veteran instructor at Lincoln Electric Co's plant. The courses consist of one 2-week training period to instruct enrollees in the technique of arc-welding the common steel alloys and non-ferrous metals. A second course of one week's duration is devoted to instruction in welding sheet metal in thicknesses from 12 to 20 gage. A third 2-week course will train students in welding of pipe in diameters from 2 to 10 in.

The continual increase in application of metal arc-welding may be ascribed in part to the concurrent advance in the development of new and improved electrodes, each designed to do specific jobs in the most efficient manner. To provide for classification of the various kinds, the American Welding Society and American Society for Testing Materials have jointly undertaken the formulation of specifications for these materials. Individual copies

MORE STEAM

LESS Fuel

COAL, OIL or GAS

CASH STANDARD

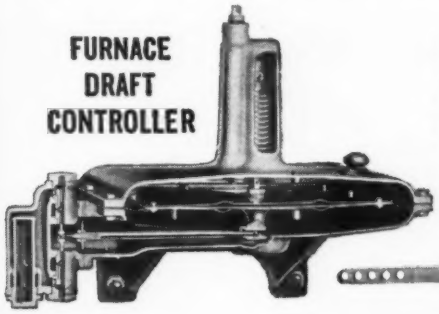
AUTOMATIC COMBUSTION CONTROL SYSTEMS

Meet any condition - - - Work on any system

This single, easily applied CASH STANDARD Automatic Combustion Control works as efficiently on multiple-boiler batteries as on single boilers. The units which make up modern, dependable, cost saving Automatic Combustion Control Systems are available in a number of variations. Combinations of these units can be arranged to give you the fullest results—(1) in boosting boiler output—(2) in economy of operation—(3) in lowest cost maintenance—(4) in reducing the fuel requirements for a given load—(5) in holding steam pressure to within very close limits—(6) in materially lowering your annual fuel bill whether you use coal, oil, or gas.

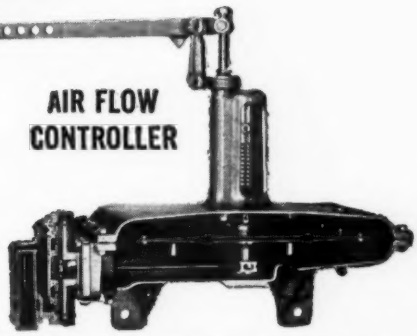
Find out full details on these units that make possible correct fuel feed—proper air supply, and constant over-fire draft—send for bulletin 300.

FURNACE DRAFT CONTROLLER

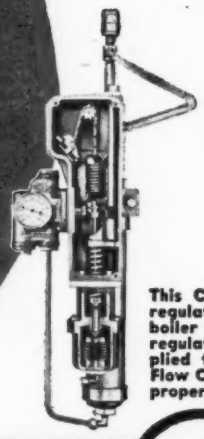


This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

AIR FLOW CONTROLLER



This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES

HI-TEST KEWANEE

FOR POWER and PROCESS STEAM

6 Sizes . . . 50 to 150 H.P. . . . 125 to 150 lbs. W.P. A quick steaming all-welded portable boiler with refractory lined firebox and 2-pass tubes to save fuel.

75 Years Boilermakers

For 6" scale with pipe diameter marking, write Department 89-K-9.

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

YOU CAN SOLVE 8 OUT OF 10 TUBE CLEANING PROBLEMS BY USING STANDARD

WILSON TUBE CLEANERS

Yes, you can solve almost all tube cleaning problems without resorting to expensive or unusual equipment—if you use standard Wilson Tube Cleaners!

A recent survey shows that 80% to 90% of thousands of tube cleaning problems presented to Wilson Engineers can be solved easily when the right combination of Standard Wilson equipment is used.

You can choose a motor, cutter head, flexible shaft or other accessory from the complete line of Wilson Tube Cleaners, and assemble a cleaner that will help you get your tubes *cleaner, faster* and save you money as well as time.

A copy of the Wilson Tube Cleaners Check List will show you how to choose the right equipment. It contains a handy Tube Cleaner Selection Guide to help you pick the right motor, cutter head and accessory for any fouled tube condition. In addition there is a list of hints on maintenance and operation that will go a long way towards making your job pleasanter and your tube cleaners last longer.

Be prepared for tube cleaning emergencies. Send for your free copy of bulletin 75 today.

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PIPE AND TUBE CLEANERS EXCLUSIVELY

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THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

of the revised specifications A233-45T, and the appended Guide, may be obtained from either the American Welding Society, 33 W 39th St, New York 18, N. Y., or American Society for Testing Materials, 260 S Broad St, Philadelphia 2, Pa., at 25¢ per copy.

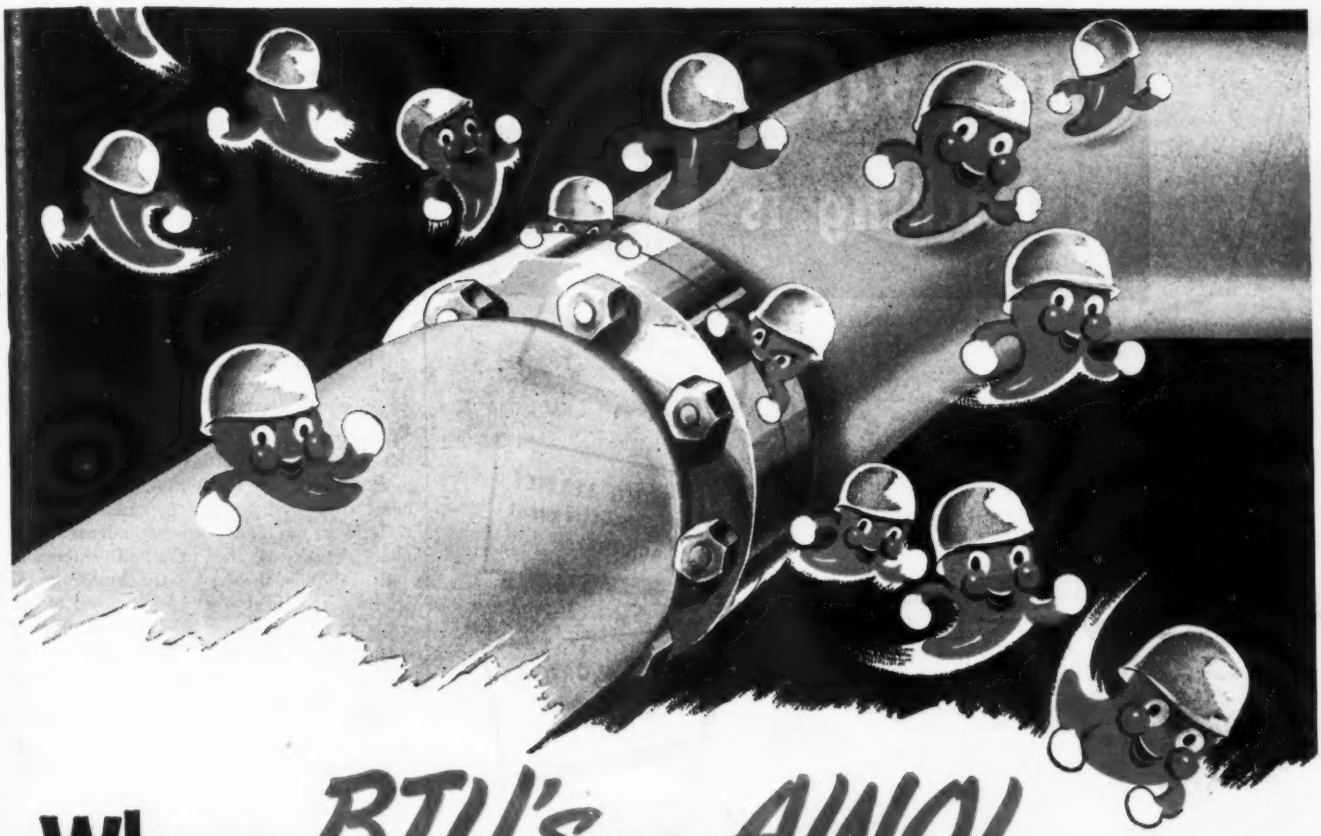
Eleven hydroelectric plants are included in the plan for diversion of Arizona's share of the Colorado River's waters to central Arizona. Three plans are suggested, of which one known as the Marble Gorge plan is considered the best in light of the preliminary data available to a subcommittee, headed by Senator Ernest W McFarland, Arizona Democrat, of the Senate Irrigation and Reclamation Committee. It entails a high dam for the diversion at Marble Gorge, near the Utah-Arizona line, a 139-mile tunnel of 3000-cfs capacity, to a point in the Verde River Valley where water would be run through a series of power plants before reaching irrigation areas around Phoenix. The project would cost $487,000,000. One power plant would be located at the diversion dam, the other ten between the tunnel's end and irrigation site.

E G Bailey, a vice-president of the Babcock & Wilcox Co, has been elected an honorary member of The Institution of Mechanical Engineers in England. Mr Bailey is the fifth American to receive the honor. Jerome C Hunsaker, head of Dept of Mechanical Engineering, Massachusetts Institute of Technology, was elected at the same time as Mr Bailey, bringing the total honorary membership of the society to 29, six of whom are Americans. The other Americans are Henry Ford, and Professor A G Christie of Johns Hopkins University, elected in 1939, Orville Wright, elected in 1942, and Dr Harvey N Davis, president of Stevens Institute of Technology, elected in 1944.

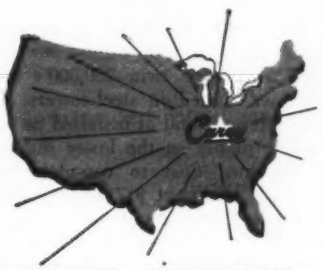
War Dept Board has authorized immediate construction of three new generator units, valued at more than one million dollars each, which would make Grand Coulee Dam the greatest producer of hydroelectric power in the world, according to William E Warne, assistant commissioner of the Bureau of Reclamation. Funds for the generators, each with a normal power load of 108,000 kw, were appropriated previously by Congress. Construction will be started as soon as contracts, which were let before the war halted work, can be brought up to date. Job will take about three years.

Electronic Progress. Scientists have created an induction electron accelerator that whirls electrons at almost five times the speed of light. This is a million-volt accelerator. Its use still is being explored, but it is expected to open vast new fields of electronic progress.

Because of the Office of Defense Transportation ban on convention travel, the fall meeting of American Society of Mechanical Engineers will be held as a local meeting at the Netherland Plaza Hotel in Cincinnati on October 2 and 3.



Where BTU's go AWOL



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Carey Industrial Insulations keep BTU's where they belong . . . on the job. Carey makes a broad line of asbestos, magnesia and rockwool insulations . . . in forms that make either ordinary or tricky jobs fast, economical, dependable and efficient.

Put your insulation problems up to Carey Insulation Engineers. They're ready to help you with expert guidance based on more than 70 years experience in industrial insulation. Consult your nearest Carey branch or write direct.

TRAINED ERECTION AND SERVICE CREWS "make sure" the job is done right.

BROAD LINE FROM ONE SOURCE. No need to compromise with desired results. You get the *right* insulation for the job.

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IN CANADA

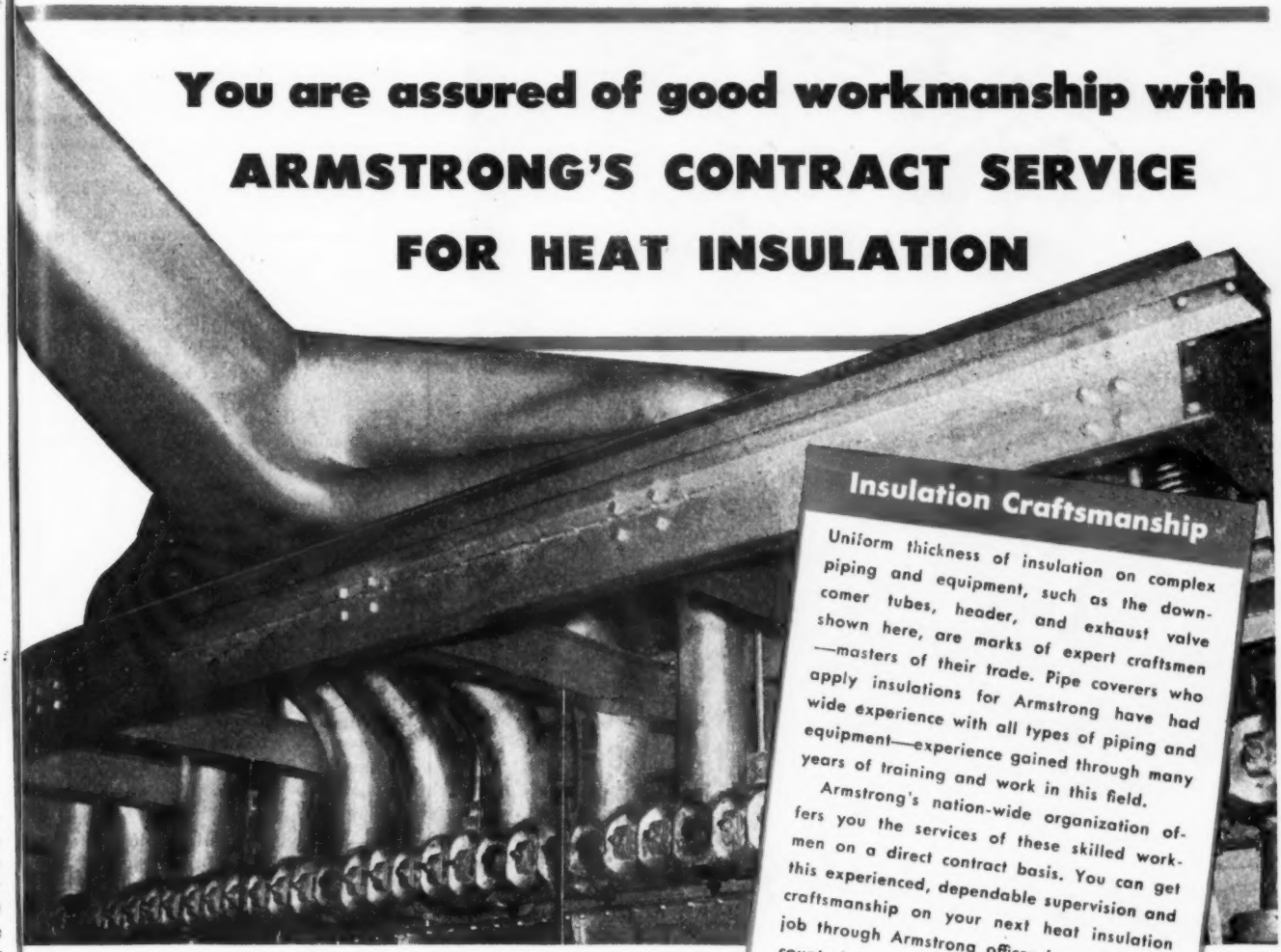
City of Winnipeg Hydro-Electric System obtained permission from the construction controller to proceed with the work of installing two 12,000-hp generating units in the Slave Falls power plant. It is planned to have them in operation by the end of 1946. Completion of the plant necessitates the raising of transmission voltage to 132,000. This requires the installation of a new outdoor transformer station at Winnipeg end of Slave Falls transmission line and a bank of transformers at Pointe du Bois plant for the interconnection of 132,000- and 66,000-v transmission systems.

Spending $1,770,000 on an extension of the generating facilities of the municipal power plant at Edmonton, Alberta, has been suggested to city commissioners by G R Watson, plant superintendent. Complete details of the proposed extension, with amounts involved, are: building, including structural steel and removal of old walls and foundations, $200,000; 30,000-kw steam turbine generator, $688,538; 155,000-lb-per-hr boilers, $590,000; boiler feed pumps, $23,062; steam piping and valves, $57,000; boiler feed piping, $30,000; electrical equipment, $127,800; coal-weigh lorry, $4600; water-circulating pump, $24,000; design and incidentals, $25,000.

B. C. Electric Railway Co plans postwar expansion of its power facilities. Shawinigan Engrg Co has been engaged to make new surveys in connection with the Bridge River hydro project. This work will cover primary development of a total of 135,000 kw, which will be made up of three 45,000-kw generators to supply the lower mainland area over twin 220,000-v transmission lines carried on steel towers. This will raise present total of installed capacity of company plants on the lower mainland to 318,000 kw. Cost to complete these facilities will be about $17,000,000. When fully developed, capacity of the project will be 600,000 kw. Construction of the first units at Bridge River will take about three years under normal peacetime conditions. In the meantime supplementary power may be acquired from the state of Washington.

Dominion Water and Power Bureau has issued its annual review of water-power resources of Canada. According to this report, the present recorded water-power resources amount to a total of 25,439,400 hp under conditions of ordinary minimum flow and 39,511,700 hp ordinarily available for six months of the year, which corresponds to a potential turbine installation of more than 51,350,000 hp. The total turbine installation as of Jan 1, 1945, is 10,283,763 hp. It is thus apparent that a large proportion of Canadian water power still awaits development. The wartime expansion in hydroelectric facilities was virtually completed in 1944. Net increase for the year was only 69,250 hp and no large power projects are immediately under construction. For free copies of Bulletin No. 2151 write to the Controller, Dominion Water and Power Bureau, Dept of Mines and Resources, Ottawa.

You are assured of good workmanship with ARMSTRONG'S CONTRACT SERVICE FOR HEAT INSULATION



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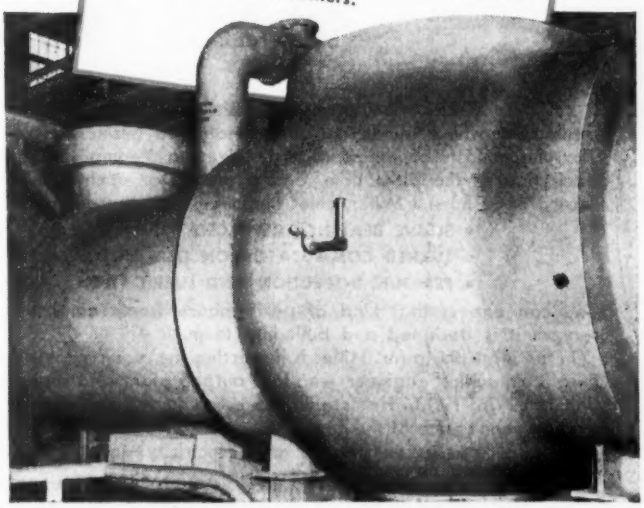
Uniform thickness of insulation on complex piping and equipment, such as the downcomer tubes, header, and exhaust valve shown here, are marks of expert craftsmen —masters of their trade. Pipe coverers who apply insulations for Armstrong have had wide experience with all types of piping and equipment—experience gained through many years of training and work in this field.

Armstrong's nation-wide organization offers you the services of these skilled workmen on a direct contract basis. You can get this experienced, dependable supervision and craftsmanship on your next heat insulation job through Armstrong offices in most of the country's industrial centers.



Experienced Workmen, under the direction of Armstrong's superintendents, install every Armstrong heat insulation job. And this expert craftsmanship is only one of the important advantages you gain when you use Armstrong's Contract Service. You also get: (1) the benefit of Armstrong's long engineering experience, (2) materials of tested and proved efficiency, and (3) the assurance that every detail of the job will be right, because a dependable organization takes full responsibility for it. Get complete information by writing today to Armstrong Cork Company, Building Materials Division, 7009 Concord Street, Lancaster, Penna.

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Complete Contract Service For All Temperatures

From 300° Below Zero

To 2600° Fahrenheit

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Yeomans Duplex Sewage Ejector, installed when Chicago's LaSalle Street Station was built, functions efficiently after 42 years.

HERE'S another distinguished Yeomans veteran—an example of equipment whose quiet, capable tending to business is taken for granted. The unit consists of the sewage receiver, a Yeomans centrifugal pump on each side at the pit-bottom, and a motor for each pump. Its maintenance record since Russell Miller, chief engineer, took charge in 1937, is as follows:

- SLEEVE BEARINGS REPLACED
- TURNED COMMUTATOR ON ONE MOTOR
- PERIODIC INSPECTION AND LUBRICATION

You can expect that kind of performance from Yeomans products, for this reason: it is designed and built into them.

In the inset photo Mr. Miller is inspecting the equipment along with William Fergus, consulting engineer, who laid out the plant and supervised its installation back in 1903. He is still interested in the equipment, for the LaSalle street station is one of the few installations left in Chicago where the power plant generates its own power and electricity—and it was his first big job.

Bulletins 6201 and 2401 give you all needed performance and installation data on Yeomans Dry-Pit Sewage Pumps. Use the coupon.

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APPOINTMENTS

Westinghouse Electric Corp acquires B F Sturtevant Co. Sturtevant becomes a wholly owned subsidiary of Westinghouse and will operate under the Sturtevant name. Headquarters of Westinghouse air-conditioning activities will be located at Boston, but heavy-duty and industrial refrigeration manufacture will continue at Jersey City, N. J.

Henry E MacArthur has been appointed manager of mfg and repair dept of **Westinghouse Electric Corp** at Huntington, W. Va. Robert F Tucker becomes manager of recently acquired *Ken-Rad* lamp div. Harry L Huntley has been made headquarters repair sales manager of 34 plants of mfg and repair dept.

Andrew H Heywood has been named manager of motor application dept of **Westinghouse Electric Corp.** H B Leidy has been promoted to manager of Middle Atlantic district mfg and repair dept. R J Miller has been transferred to Emeryville, Calif., as asst manager of Pacific Coast district mfg and repair dept.

Westinghouse Electric International Co appoints J A Civilett asst resident representative at E Pittsburgh, Pa.

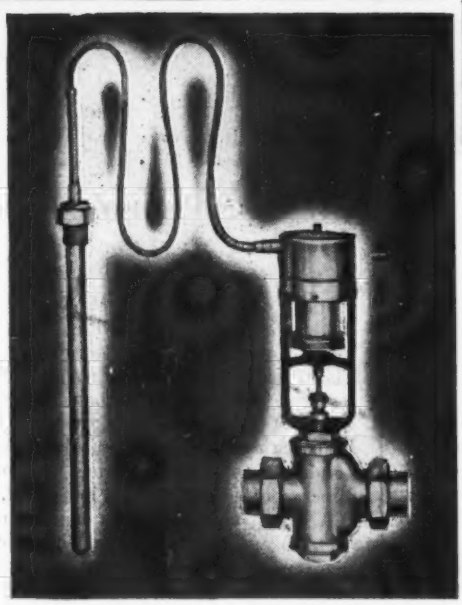
Harvie L Sykes, Jr, joins Middle Atlantic district of **Westinghouse Electric Corp,** lamp div, as district engineer. Appointment of G A Hyland as sales manager of new aviation gas-turbine div and William A Mechesney as manager of contract negotiation dept for the same div has been announced. Ralph R Brady has been made mgr of electric discharge lamp sales.

Cooper-Bessemer Corp appoints Northern Marine & Engine Co, Toronto, Canada, as its representative in Ontario, Quebec, New Brunswick, Labrador and Prince Edward Island. Stanley E Johnson, general sales manager, was elected a vice-president and member of board of directors and Charles G Cooper, manager of Washington office, was elected to board.

Formerly works manager of Holyoke, Mass., plant of **Worthington Pump & Machinery Corp,** Harry A Feldbush has been named vice-president in charge of engineering for the entire corp. His headquarters will be at general offices in Harrison, N. J. Ralph M Watson has been appointed assistant to Mr Feldbush.

Detroit diesel-engine div of **General Motors Corp** appoints E F Bentley as contractors' equipment sales manager. Mr Bentley succeeds A N Anderson, now Detroit diesel-engine dealer in Los Angeles.

Fred E Harrell has been made general works manager of **Reliance Electric & Engrg Co,** succeeding S B Taylor, who has resigned as mfg vice-president but will remain a member of board of directors. William R Hough has been named chief engineer succeeding Harrell. Reliance appoints two new distributors: Standard Elec-



923 Sylphon Regulator. This instrument automatically eliminates need for manual control . . . ensures continuous flow of hot water at a uniform temperature.

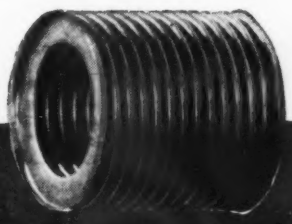
Keep her in HOT WATER

Fully Modulating Control...Low Cost

To ensure the constant flow of hot water of uniform temperature from storage, for hotel, apartment house or industrial use, Sylphon Regulator No. 923 is the control most widely recommended.

This instrument is self-contained, requires no auxiliary power, therefore does not cease to function in the case of line or compressor failures.

Fully modulating, No. 923 ensures a continuous supply of hot water at a *constant "set" temperature*. Furthermore, it is sturdy, compact—designed and constructed for many years of faithful service. The first cost is low . . . operating and maintenance practically nil over the years. Write for Bulletin RS-20.

FULTON  **SYLPHON**

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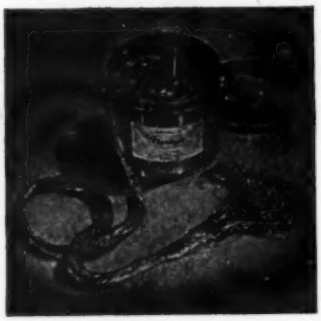
the Universal Packing for ALL NEEDS

Whether for pumps, compressors, engines or valve stems —for water, steam brine, air, oil or gas—"AMBEST" solves the packing problem. It is the universally adaptable packing for every kind of service and recommended for use where rods are in good condition. Suitable for pressures and temperatures up to 550 deg.

"AMBEST" is an anti-friction metallic packing, in shredded, long pliable strands, lubricated and graphited —made in one size for all applications—No Waste or Misfit. Stays pliable—will not scratch. Try it once and you'll use it always.



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GAUGE GLASS NEEDS ARE WIDELY VARIED

An important factor in the service life of any gauge glass is the selection of the right glass for a specific purpose. From four different types of gauge glasses in the CORNING and PYREX complete line, you can select the one best suited to your service requirements.

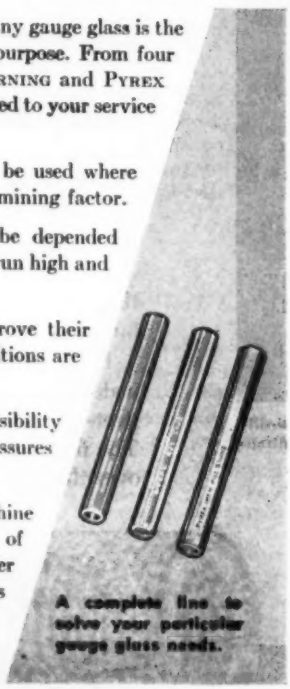
1. CORNING Standard Gauge Glasses should be used where pressures are moderate and low cost is a determining factor.

2. PYREX High Pressure Gauge Glasses can be depended upon to give outstanding service where pressures run high and over-all economy means more than initial cost.

3. PYREX Broad Red Line Gauge Glasses will prove their value for high pressure service where lighting conditions are poor and maximum visibility is demanded.

4. PYREX Red Line Gauge Glasses offer greater visibility than that of a plain gauge glass for services where pressures are high.

Because all of these gauge glasses are made with machine drawn accuracy, they are easy to install without danger of breakage from installation strain. They will stand up under severe service conditions when they are used for the pressures for which they are recommended.



A complete line to solve your particular gauge glass needs.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

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Corning Gauge Glasses

tric Motor Works of Detroit will supplement the activity of company's district office in the automotive center. In Milwaukee, C & G Sales & Engrg Co will extend the service of Reliance's Central Western sales district.

Appointment of Paul J Moore as motor sales manager of **Star Electric Motor Co** has been announced by Ivor M Peterson, vice-president and general sales manager of the company.

Cutler-Hammer, Inc, announce appointment of F A Wright as asst general sales manager. Mr Wright has been associated with Cutler-Hammer since 1927.

C D Belt & Co, 1530 16th St., Denver, Colo., have been made district sales representatives for **Allen-Bradley Co.** Belt organization will cover state of Colorado, panhandle of Nebraska and southern part of Wyoming.

Appointment of Robert V Lackner as field engineer for **Allis-Chalmers Mfg Co's** Pittsburgh district office was announced recently.

Peabody Engrg Corp announces executive changes: **David P Graham,** assistant to the president, was made second vice-president and a member of board of directors. Charles B Hill continues as first vice-president. Clarence A Snider is now treasurer and H Victor Crawford secretary.

Death of R R Ware results in new appointments at **Clarage Fan Co.** Harry R Clarage succeeds Mr Ware as president. Robert A Wasson was elected to the board and chosen vice-president and general manager.

Fedders Mfg Co appoints Robert W Morgan chief engineer. Mr Morgan will direct all engineering activities at Fedders.

Plans for establishment of an engineering research dept and for expansion and reorganization of present engineering activities were announced by **Standard Oil Co (Ind.).** George W Watts has been named director of engrg of the mfg dept, and D A Monro, chief designing engineer of the dept. Mr. Watts will be in charge of all engrg work in the mfg dept but will devote his time principally to engrg research dept. All other engrg activities will be under direct charge of Mr Monro. P L Krauel has been appointed chief engineer of the engrg div, Whiting Refinery. Mr. Krauel will serve as administrative head of the div, which has been enlarged to include six departments, each to be headed by an asst chief engineer.

Oil design dept of **Standard Oil Co (Ind.)** will be supervised by W G Guild, acting asst chief engineer. A T Milbrook, asst chief engineer, will supervise utility design dept. W K Brown has been appointed acting asst chief engineer in charge of newly created plant engrg dept. This dept will handle engrg matters pertaining to construction, inspection and field engi-

HIGH THERMAL RATINGS

Philadelphia...
WORM GEAR
Speed Reducers

Adequately proportioned housings that permit proper heat radiation have been achieved in the design of Philadelphia Worm Gear Reducers without sacrificing compact construction. This feature is of particular advantage in reducers selected for continuous service where thermal rating must be the determining basis.

Another advantage in Philadelphia design of housings is the rib construction which has been extended and rounded out into a smooth attractive design, stronger, more rigid and more rugged than the conventional, approved design.

Superior housings are but one of many reasons for selecting Philadelphia Worm Gear Reducers. Philadelphia Worm Gear units are made for vertical and horizontal drive conditions in a full range of horsepowers and reduction ratios. Our Catalog No. 25 will give you full construction details. Write on your business letterhead.

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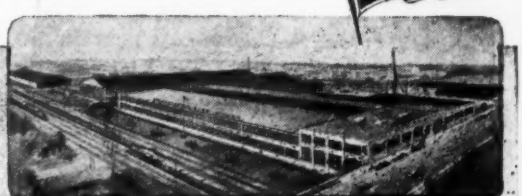

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

HONAN-CRANE MEN Are Trained Oil Purification Engineers

Honan-Crane oil purification equipment is sold ONLY by trained Oil Purification Engineers—skilled technicians capable of making an intelligent analysis of any problem involving dirty or contaminated oils. These men are also capable of supervising the proper installation of Honan-Crane equipment to give you maximum oil purification protection against acids, sludges, abrasives, other damaging contamination.

Keeping oil clean pays big dividends in reduced maintenance and increased production in the operation of Turbines, Internal Combustion Engines, Hydraulics, Machine Tools, Compressors and other industrial equipment. Put this Honan-Crane Oil Purification Engineer to work on your problem—he will be one of the most important men in your plant. A Honan-Crane Engineer will call at your convenience. Write today.

HONAN-CRANE CORPORATION
Subsidiary of Houdaille-Hershey Corporation
1200 SIXTH STREET LEBANON, INDIANA

Honan-Crane has had more than 20 years of experience in engineering and building oil purification equipment.

neering, and will furnish consulting service to operating and design departments. C E Dyckman is made asst chief engineer, estimating dept, and will continue to direct and supervise work of estimating engineers. W R Burrows will be in charge of engrg development dept, with title of asst chief engineer. D F Purdy, asst chief engineer, will continue to supervise drafting dept. Rubert J Lindquist becomes financial vice-president.

Baldwin-Hill Co. Trenton, N. J., appoints T D Slingman manager of industrial sales. Mr Slingman was formerly vice-president of mechanical sales of Dayton Rubber Mfg Co and had previously been associated with Fairbanks Morse Co, Duriron Co and Chicago Pneumatic Tool Co.

Sullivan Machinery Co changes location of its Pittsburgh office to 4107 Sennott St.

R M Wade & Co, Portland, Ore., represents **Yeomans Bros Co** in Oregon and southwest Washington.

John R Cameron has been made Michigan representative for various products of **Whiting Stoker Sales Co.**

With plans for extensive coverage by St. Louis retail branch in the wide postwar stoker market, the **Iron Fireman Mfg Co** has appointed Karl E Saboe as the branch's new manager.

Canton Stoker Co appoints J W Miller, Jr, as district manager of New York State, with central offices at 204 State Tower Bldg, Syracuse, N. Y. L C Dubs has been elected vice-president and general manager of the company.

Piezo Mfg Corp becomes exclusive manufacturer of all remote-control equipment formerly manufactured by Piezoelectric Corp.

American Engrg Co announces appointment of Mid-West Heat Service, 3336 Franklin Blvd, Chicago 24, Ill., to represent the *AE-Taylor* and *AE Perfect-Spread* stokers in northern Ill. and Ind., including the Chicago metropolitan district.

George C Richards has been appointed eastern district sales manager for **National Electric Products Corp,** Pittsburgh. G D Wells now represents the company in Baltimore, Md. Mr Richards will make his headquarters at 9 Rockefeller Center, New York 20, N. Y. After service with the Armed Forces, William C Robinson, Jr, has again assumed vice-presidency of the company and Dudley W Rice has rejoined the organization as manager of surface raceway dept.

Brown Instrument Co, a wholly owned subsidiary of Minneapolis-Honeywell Regulator Co, elects Henry F Dever president. Charles B Sweatt, vice-president and director of Minneapolis-Honeywell, has withdrawn from Brown and will devote his attention to supervision of expanded sales activities of the Honeywell organization and its subsidiaries. Mr Dever will also

Controlled Quality

Quality is *built into* all Shaw Pre-Fabrication . . . we do not rely on just one inspection after the assembly is completed. Our policy is, as always, to make a careful, accurate check-up at every step during the production. This policy of continuous inspection is your assurance of controlled quality . . .

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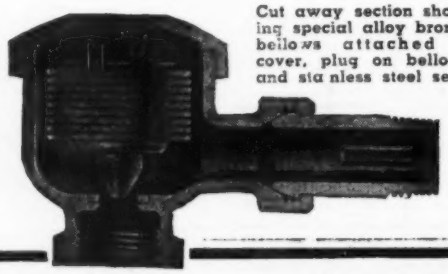
The **CRYER** Thermostatic **RADIATOR TRAP**



Cut away section showing special alloy bronze bellows attached to cover, plug on bellows and stainless steel seat.

A DEPENDABLE "GO" AND A SURE "STOP"
for water and air **FOR STEAM**

Simple, efficient and continuous, trouble-free, operation over long periods of service can be definitely depended on. The CRYER will function uniformly without attention, waste or noise on any two pipe low pressure steam, vapor or vacuum system. Water, air and gases are permitted to pass from radiator to return line while steam is prevented from doing so.

Designed for a maximum pressure of 30 lbs. the CRYER conforms in dimensions to the standards adopted by the Heating & Piping Contractors' National Association. Made in ½" and ¾" sizes; ratings 300 and 400 ft. radiation. Complete details available on request.

***Also:* CRYER INVERTED BUCKET Steam Traps**
in capacities from 500 to 38,000 lbs.; all sizes and repair parts for the J-M Ball Steam Trap.

CRYER TRAP AND VALVE CO. INC.
Manufacturers of steam specialties for more than 40 years.
366 MADISON AVE. NEW YORK, N. Y.

Coal Storage a 1-Man Job
with the
SAUERMAN SYSTEM

Above is a small Sauerman Scraper System handling a stockpile at a power plant serving two textile mills. With this simple installation, one man is able to stock out a large train-load of coal in a few days' time and then reclaim at regular intervals whatever tonnage the plant requires. This Sauerman unit has operated steadily for 14 years—never has demanded much attention or repairs—will continue to give the same dependable service for many years to come.

Compact Piling • Safer

AT A GREAT SAVING!

Whether your annual coal storage requirements amount to only a few thousand tons or a million tons, there's a size and type of SAUERMAN Scraper System to take care of your storing and reclaiming cheaper and with less manpower. But that's not all. It makes best use of available space by building high piles in compact layers—leaves no airpockets for spontaneous combustion—reduces dust and dirt. One man easily handles it with one set of automatic controls. Low initial cost. Upkeep simple.

Send for Sauerman Catalog.

SAUERMAN BROS., Inc.
562 S. Clinton St., Chicago 7, Ill.

assume responsibilities of E B Evleth. Engineering activities of the parent company will be under direction of W J McGoldrick.

Taylor Instrument Companies announce changes in sales organization: Raymond E Olson has been made general sales manager to head up all of the various sales activities, both domestic and foreign. Functioning under Mr Olson will be Frank S Ward, new industrial sales manager. Ralph E Clarridge assumes duties of sales engrg manager and W Maben Griffith commercial sales manager.

Announcement of a new office at 211 State St, Bridgeport, Conn., has been made by Alfred B King & Co, distributors of arc welders and welding supplies for **Lincoln Electric Co.** Howard Pennington will be in charge of the office.

Frank H Gaylord returns to **Hoffman Specialty Co** as vice-president in charge of market development. C W Little has been appointed asst general sales manager, working under C W Stewart, vice-president and general sales manager. A newly created Hoffman jobbed products div is being headed up by E Nute Sanbern as manager.

William P Hubbard, Jr, has been elected president and treasurer of **Ashton Valve Co.** J W Motherwell has been made chairman of board, succeeding Ellery Peabody.

Board of directors of **Homestead Valve Mfg Co** authorized appointment of Don H Krey as sales manager and Elliott G Johnson as asst sales manager.

Wm Powell Co announces appointment of Allen B Stiles as manager of Philadelphia and Baltimore territory. Mr Stiles' office is at 1520 Locust St, Philadelphia 2, Pa.

American District Steam Co appoints Engrg Equipment Co, 1532 Madison Rd, Cincinnati 6, Ohio, district representatives for Cincinnati and vicinity and Weeks Engineering Co, 4526 Olive St, St. Louis 8, Mo, district representatives for eastern Missouri and southern Illinois.

S Logan Kerr becomes associated with **Fischer & Porter Co** as supervisor of all dynamic engrg and development work.

Joshua Hendy Iron Works appoints James L Ray to head the gas- and steam-turbine engineering dept in San Francisco and supervise considerable enlargement of its technical staff.

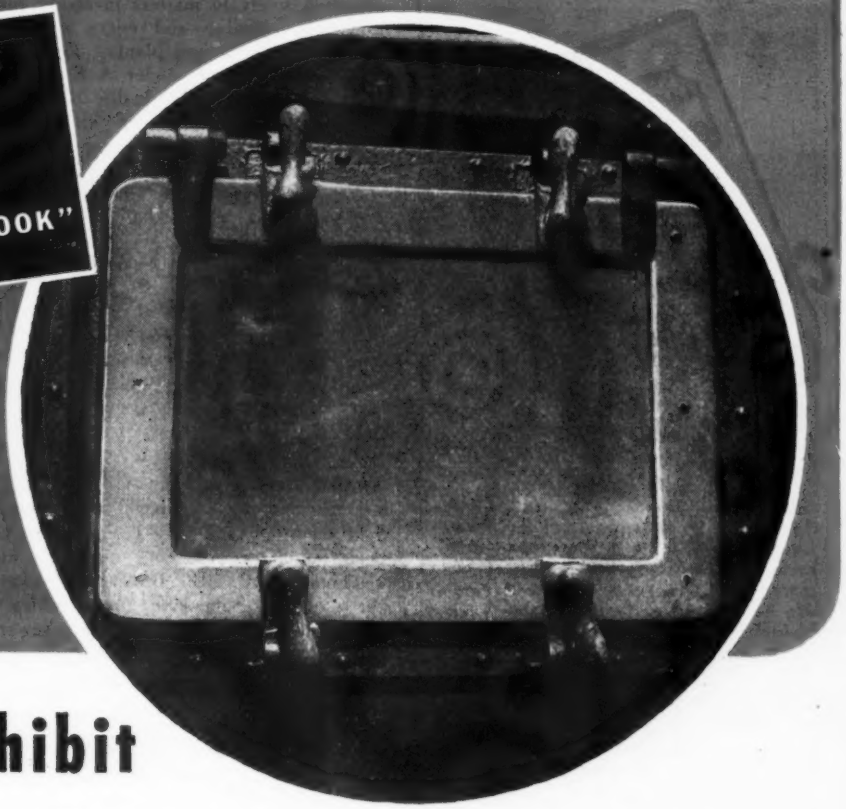
In preparation for more intensive sales activity, **Robins Conveyors, Inc,** has reorganized its sales dept, which continues under the direction of Harold Von Thaden. E C Salzman assumes responsibility for all export operations. He will be at 70 Pine St, New York, N. Y. Moving to Passaic from the Chicago office, J F Meissner takes over control of all engrg sales and of the

PAGE 3

OAKITE

"PRESCRIPTION NOTE BOOK"

ONE OF A SERIES of data sheets for power plant engineers outlining various Oakite maintenance and equipment cleaning tasks. Each sheet may be filed for reference to serve as a reminder for obtaining more specific information.



New way to inhibit SLIME and SCALE in air conditioning and humidifying equipment...

Developed by the Oakite Research Laboratory, a NEW chemical development is now available that provides a successful answer to the problem of controlling and inhibiting slime, odors and lime scale in closed systems of water-wash air conditioning equipment . . . or in humidifying equipment designed to maintain a high relative humidity in connection with processing or manufacturing operations.

This NEW material . . . Oakite Airefiner No. 52 . . . is a white, free-flowing powder, completely soluble in water and odorless in both dry and solution form. Economical, safe to use and non-toxic, its highly effective germicidal and fungistatic properties are extremely potent in controlling slime formation and growth of mold organisms. You merely add Oakite Airefiner No. 52 to water supplies in the recommended concentration. A free 3-page Special Service Report gives you further details. Write for your copy today.

OAKITE PRODUCTS, INC., 23 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

Other Power Plant Cleaning Jobs for OAKITE

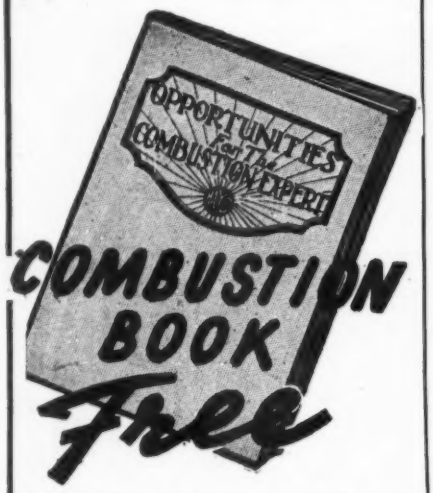
Automatic Filters . . . Electrical Precipitators . . . Controlling Slime and Scale Formation in Air Wash Air Conditioning Units . . . Cleaning Evaporative Condenser Coils . . . Controlling Slime and Mold in Humidifying Systems . . . Cleaning and Descaling Diesel or Gasoline Engines . . . Cleaning and Descaling Jacket Water Coolers and Lube Oil Coolers . . . Cleaning Surface Condensers . . . Cleaning Water and Steam Condensate Meters . . . Descaling Water Cooled Compressors . . . Cleaning Unit Heaters . . . Descaling Ammonia Condensers . . . Cleaning Transformers . . . Cleaning Painted Surfaces of Equipment . . . Stripping Paint . . . Cleaning Floors.

NOTE: The Oakite Technical Representative in your locality is ready to give you the benefit of his experience and personal help on any power plant cleaning or related problem. This Advisory Service is free.

OAKITE

Specialized cleaning

MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT



Combustion efficiency as applied to Boiler Plant Operation. Fuels and Equipment is now a most important factor in defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.

The Combustion trained man—the Hays trained man — can do his part, and open up big opportunities for himself that never existed before, by devoting a little of his spare time in training himself to meet present conditions.

Just a Few of Our Hundreds of Friends	
International Harvester Co.	20
Armour and Co.	75
Combustion Engineering Company	45
Riley Stoker Corp.	75
Iron Fireman Mfg. Co.	35
Commonwealth Edison Company	145
State of Illinois.	85
Cities Service (Oil & Power).	70
and many others.	

How? Through the simple, easy reading, *practical* Hays Home Study Course in Fuel and Combustion Engineering. For 26 years the Hays Institute has specialized exclusively in training in Combustion Efficiency. Hundreds of Hays trained men now hold substantial positions of responsibility. What we have done for them we can do for you, in your spare time. Many companies urge their men to enroll. They know the value of Hays Combustion Training.

SEND FOR FREE BOOK

The coupon below will bring you, without expenses, full particulars regarding the Hays short, practical, easy reading, home study Course in Combustion. Do your part by starting now to train yourself in the uncrowded wide open field of Fuel and Combustion Engineering. Hays trained men are in demand, today more than ever. Send the coupon Now. No obligation of course.

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Our 26th Continuous Year . . .

Hays Institute of Combustion,
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Please send me your Free Book "Opportunities for the Combustion Expert"—No Obligation.

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City ..... State.....

Company Name .....

field engineers who devote their time and attention solely to matters involving functions of designing and engrg materials-handling projects and plants. Equipment sales section is now under A E Conover. His responsibilities include direction of that portion of field engrg staff who concern themselves with sale of equipment, where little or no engrg is involved. Sales research and training has been put under T W Matchett; advertising and sales promotion remain under E M Perrin; engrg dept continues to be headed by R W Eichenberger.

C H Wheeler Mfg Co has made T S Ryan their California representative. He is located at 215 Rialto Bldg, Mission and New Montgomery St, San Francisco 5, Calif.

Ampco Metal, Inc, appoints S C Lawson asst general sales manager in charge of field operations. Philip F Erlandson has been made eastern zone manager, with headquarters at 1060 Broad St, Newark, N. J. He is responsible for activities of field engrg offices in Hartford, Newark, Philadelphia and Washington, D. C. William J. DeMuth has been transferred to Newark, N. J., where he becomes district manager of this territory. W T Peterson has been transferred to Detroit where he becomes central zone manager, in charge of offices at Detroit, Cleveland, Pittsburgh and Buffalo. Cleveland and Pittsburgh offices are to be operated as one territory with Emil Svoboda as district manager. John C Kemp has been made field engineer at Cleveland and Baxter Schroeder field engineer at Buffalo.

New Midwestern zone manager of **Ampco Metal, Inc,** is W B McKenzie. He has charge of offices at Chicago, Indianapolis, St. Louis and Cincinnati. Jack Bybee has been transferred to Milwaukee where he becomes district manager. J W Nebel becomes district field engineer at Milwaukee. Henry A. Mullen joins sales dept and is attached to Detroit field engineering office as resistance-welding consultant. Fred Opitz has been appointed export manager of new export sales dept.

Plibrico Jointless Firebrick Co announces following appointments: W R Griffith as manager of Plibrico Sales & Service Co, Akron, Ohio, succeeding Carl V Faber, retired; Carl C Grimes, Jr, as manager of Plibrico Sales & Service Co, Des Moines, Iowa; John W Wright as manager of Plibrico Sales & Service Co, Fort Wayne, Ind., succeeding Frederic L Ruoff who has been transferred to Chicago headquarters as manager of nation-wide construction dept.

Briggs Clarifier Co announces appointment of W J Sommers, 505 Delaware Ave, Buffalo, N. Y. as distributor covering western New York State and northwestern Pennsylvania.

Bendix Aviation Corp forms a new div, Bendix International, to handle their foreign trade program. Bendix International will be under the direction of Charles T

CHANGE
of Management
AT
FRANCE
PACKING

E. A. France, son of Adam Warren France, who patented France Metallic Packing and founded the business nearly fifty years ago, is now president and general manager. J. C. Allen is the new treasurer. Both Mr. France and Mr. Allen have been active in the manufacture of metallic packing for many years.

The new management pledges that it will produce the same high quality metallic packing that has been operated so successfully in engines, pumps and compressors under all conditions of service for nearly half a century. Furthermore, every effort will be made to reorganize the business in order to improve service and delivery.

Remember the Name, FRANCE, Standard of the Industry.

FRANCE
PACKING COMPANY
PHILADELPHIA 35, PA.

MOST SHORT CENTER DRIVES SLIP TOO MUCH ...NOT THIS F. L. A. T. DRIVE

ESPECIALLY WHEN BELTED BY "RESEARCH"

Belt slip . . . which wastes power and burns belts . . . is caused by insufficient belt tension or insufficient belt grip. Neither of these faults can exist on a Flat Leather Automatic Tension drive equipped with "Research" leather belt.

The pivoted base of the F.L.A.T. drive automatically adjusts belt tension to accommodate varying loads. And the high-friction, pliable "Research" belt hugs the small pulleys with maximum pulley grip.

Careful checking of hundreds of cases where "Research" has been used with the F.L.A.T. drive, has proved more power delivery at rated load than a comparable V-belt drive; and this efficiency is maintained under conditions (above or below rated load and rated tension) where efficiency of other types of belting drops way down.

The life of a "Research" leather belt on F.L.A.T. drive exceeds that of a V-belt on a comparable drive, which is further proof that slippage is much less on this type of drive.

Ask your Graton & Knight distributor for a demonstration.

"Research" Leather Belting is the belt recommended for dependable, trouble-free service on Flat Leather Automatic Tension drive.

An exclusive "weight-controlled" currying, which works back into the leather the proper amount of life-giving, life-preserving natural lubricants, is responsible for the high coefficient of friction and extreme pliability. "Research" hugs the small pulley with minimum slip and takes the continual flexing without excessive wear or waste of power. Its load-carrying capacity actually *improves* with use.

Write for new, free Belting Manual — to Graton & Knight Company, 333 Franklin Street, Worcester 4, Mass.

GRATON AND KNIGHT

Research Leather Belting

from Graton & Knight's line of leather belting—the most complete for all applications. Graton & Knight distributors are listed under "Graton & Knight" in "Belting" section of Classified Telephone Directory and THOMAS' REGISTER.

PATENTED

INCREASED PRODUCTION FOR REFRIGERATION USERS

● You Can Obtain Greater Refrigeration Capacity from your Present Compressor by using NIAGARA DUO-PASS AERO CONDENSER.

This is possible because you use outdoor air as the cooling medium with the extra benefit of evaporative condensing! Condensing temperatures are lowered; condenser capacity is increased; head pressures are reduced—additional compressor capacity is the result.

Only the patented NIAGARA Duo-Pass makes this gain permanent because no other evaporative condenser lowers condensing temperatures to the point where deposits do not accumulate on condenser tubes. This does away with loss of time for cleaning and assures always full capacity.

Write for Bulletins 91 and 93.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. P-95, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Zaoral, general manager. The new div will handle throughout the world, with the exception of U. S. and Canada, the products of the 17 divisions of the corp. It has established headquarters at corp's New York office, 30 Rockefeller Plaza.

James S Wilson has been advanced by **Watson-Stillman Co** to manager of plastics equipment sales. Prior to his present assignment, Mr Wilson headed the Watson-Stillman plastics molding laboratory.

Carborundum Co appoints William H Homeyer and Francis J Blake district sales managers. Mr. Homeyer, with headquarters at Los Angeles, is to have charge of southern California sales area and Mr Blake, whose headquarters will be in San Francisco, will have charge of northern California sales area.

E A France is now president and general manager of **France Packing Co.** J C Allen is the new treasurer.

Transfer of Dr Wendell P Metzner to **Monsanto Chemical Co's** central research laboratories at Dayton, Ohio, has been announced. At Dayton, he will head the flexible high-polymer group. Dr Metzner will be succeeded as a group leader in organic chemicals div research laboratories by Harold L Hubbard. Dr Alfred C Rossow is being transferred from Dayton to the St. Louis research laboratories. Robinson Ord has been appointed general manager of sales of organic div. Arthur P Kroeger becomes asst general manager of organic div sales and Charles H Sommer, Jr, assumes responsibility for sales of intermediates as well as plasticizers and resins.

Davidge H Rowland has joined the staff of **Porcelain Insulator Corp** as ceramic research engineer. In that capacity he will assume responsibility for continuing development of *Pinco* insulators and specialties.

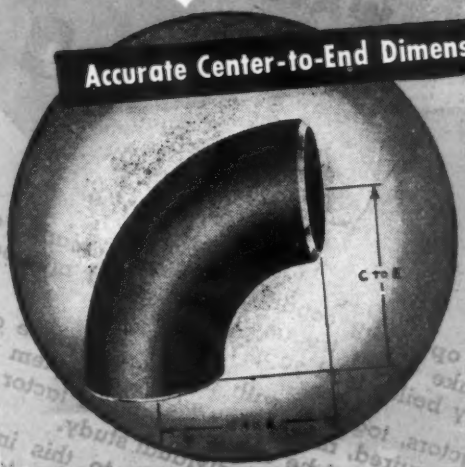
Laclede-Christy Clay Products Co elects John L Cummings vice-president and director of sales and Julius A Kayser vice-president and general sales manager. Harvey R Hiller and John W Rogers were appointed asst vice-presidents.

At a meeting of board of directors, A G Bussmann and L D Granger were elected vice-presidents of **Wickwire Spencer Metallurgical Corp.** Mr. Bussman is also vice-president in charge of sales of Wickwire Spencer Steel Co and Mr Granger vice-president of American Wire Fabrics Corp. Mr Bussmann will be located at 500 Fifth Ave, New York, N. Y., and Mr Granger at 260 Sherman Ave, Newark 5, New Jersey.

Link-Belt Co appoints A C Fellinger sales manager, power-transmission machinery, with headquarters at Ewart plant in Ind. Sale and application of silent chain drives will be headed up by H F R Weber, divisional sales manager, silent chain drives, with headquarters at Ewart plant. G H Woody continues as sales manager of ball and roller bearing div at ball and

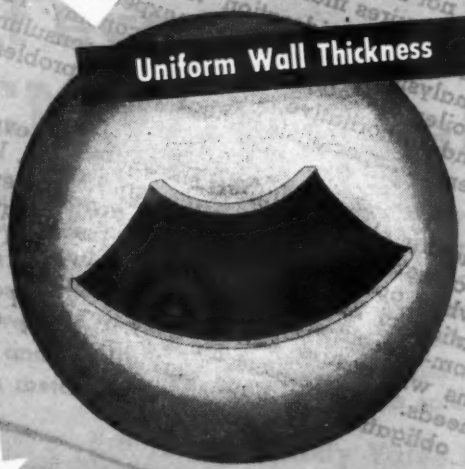
IMPORTANT FEATURES OF MIDWEST WELDING ELBOWS That Save Time and Money

Accurate Center-to-End Dimensions



Exact Included Angle

Uniform Wall Thickness



True Circular Section

Midwest Welding Elbows possess the features shown here to an unusual degree because of: (1) a unique manufacturing process whereby the final "size-forging" is in compression in totally enclosing dies that exactly control the metal distribution and (2) special machines for simultaneously machine-beveling both ends and holding the included angle within extremely close limits.

The importance of these features cannot be overemphasized . . . they simplify piping layout . . . they save time in lining up and welding . . . they permit better welds . . . they mean a better piping job.

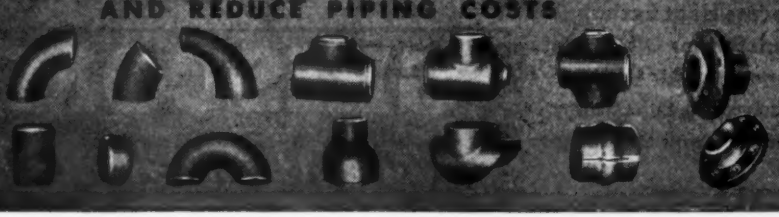
MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Sales Offices: New York 7—(Eastern Division) 30 Church Street • Chicago 3—645 Marquette Bldg. • Los Angeles 33—320 Anderson Street • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • South Boston 27—426 First St. • Atlanta 3—Red Rock Bldg.

Distributors in Many Cities

MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS



WHICH SHOULD YOU USE?

ONE OF A SERIES OF ADVERTISEMENTS DESCRIBING THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

In some plants, the operating conditions, steam demands and quality of raw water make water treatment the logical method of maintaining a satisfactory boiler feed supply.

In other plants, these factors, together with the heat balance of the plant or the % makeup required, make an evaporator system advisable. The size of the plant may not be as determining a factor as the plant processes, and each case requires individual study.

Every plant engineer should give consideration to this important matter, because thorough analysis may develop unexpected possibilities of improvement in boiler operation and plant economy. You can obtain a thorough . . . and authoritative . . . analysis by consulting the Griscom-Russell engineers . . . specialists in heat transfer problems for more than 70 years.

If their study of your particular plant conditions shows that an evaporator installation is unnecessary, they will tell you so, frankly. If, on the other hand, worth while operating or economic advantages can be produced by distillation of boiler feed makeup, the unequalled experience of the Griscom-Russell engineers in developing and applying evaporator systems will assure you the most suitable type of installation for your needs. Your request for a plant survey will not involve the slightest obligation on your part. Write for complete information.

G-R BUILDS ALL THESE UNITS FOR HEAT TRANSFER SERVICE . . .

Evaporators
Stage Heaters
Gas Coolers
Drain Coolers
Aftercoolers
Air Preheaters
Fuel Oil Heaters
Jacket Water Coolers
Process Heat Exchangers
Transformer Oil Coolers
Generator Air Coolers
Lubricating Oil Coolers
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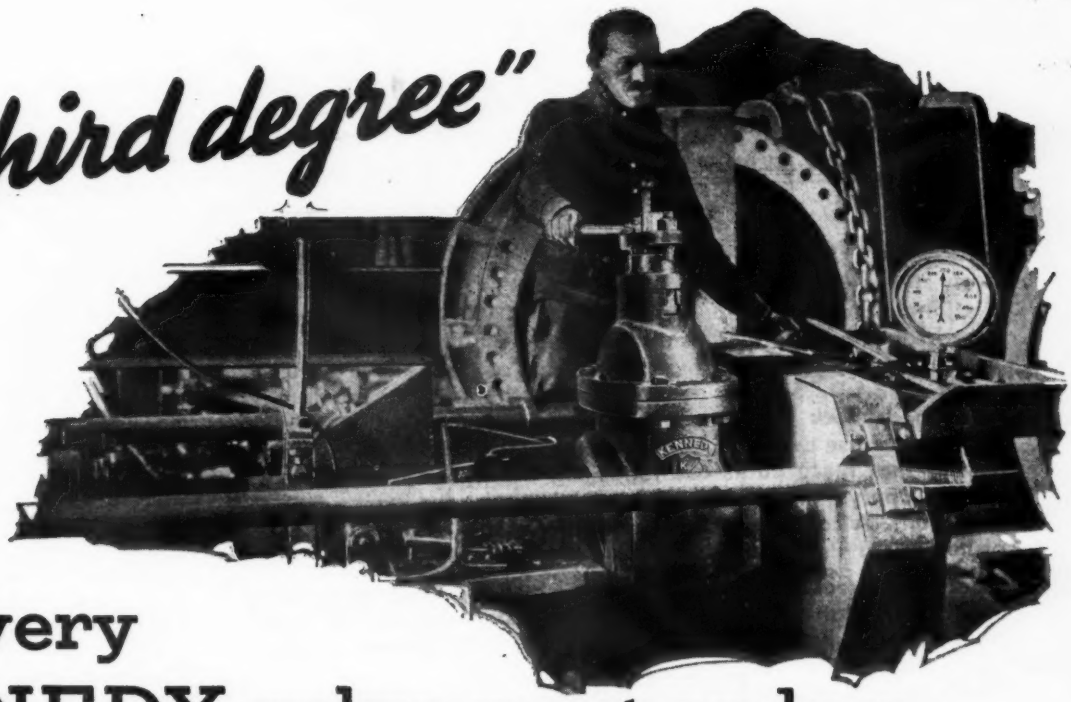
THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

The "third degree"



that every KENNEDY valve must endure

When the Kennedy Tester finishes with a valve, he knows—and knows definitely—whether or not it is perfect in every respect. His cross examination is thorough and relentless. It covers every detail of the valve from flange faces or hex threads to handwheel; and is sure to uncover any flaw that may exist in metal, joints, or mechanism. His sole job is to detect imperfections and he is entirely independent of the Production Department. That is why you can be sure that every Kennedy Valve . . . Iron Body or Bronze . . . Gate, Globe, Angle, or Check . . . has actually proven that it will withstand far more than its rated pressure, will seat tight, release promptly, and operate dependably.

The Kennedy Valve Mfg. Co., Elmira, New York

KENNEDY valves . . . pipe fittings . . . fire hydrants

"Field Hospital"

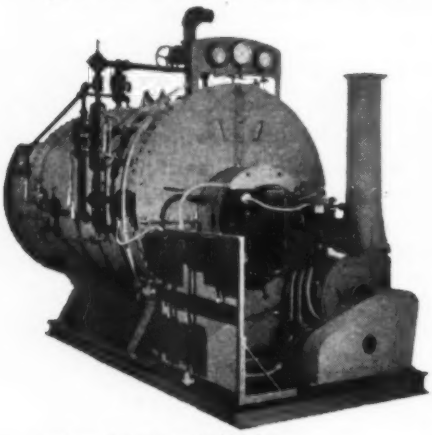
FOR FIGHTING SHIPS

Powered by 10 Preferred Unit Steam Generators

Truly "Field Hospitals of the Sea", the "A.B.S.D."—Advanced Base Sectional Dock—pictured above, together with her sisters have cared for 176 "wounded" ships in a single eight-month period! Built in ten sections and moved as close as possible to combat areas, "A.B.S.D." Sections are welded together into one mammoth floating drydock with a capacity of 56,000 to 100,000 tons—enough to raise even our largest battleships. Because of the vital service that these docks are rendering our fighting fleets, their power supply must be dependable, even under the most adverse conditions. A continuous flow of steam to the "A.B.S.D." is furnished by a Preferred Unit Steam Generator in each section.

What better reason could you find to place your full confidence in a power plant than its efficient, war-tested service, far from sources of maintenance and supply for indefinite periods of time.

When you purchase a PREFERRED UNIT STEAM GENERATOR you can count on these outstanding features:



- **Overall efficiency stepped up to guaranteed 80% minimum.**
- **No stack or chimney required.**
- **Induced draft eliminates the danger of forcing the products of combustion into the boiler room.**
- **Long life of the refractories.**
- **100% automatic operation . . . with Bunker C or #6 Oil.**
- **Unit construction . . . little floor space . . . easily set up.**

Send in the coupon below—it will bring you complete information on Preferred Unit Steam Generators.

Preferred Utilities Mfg. Corp.
1860 Broadway, New York 23, N. Y.

Please send me Bulletin 1000, describing Preferred Unit Steam Generators. Also the booklet DIVIDENDS FROM YOUR POWER PLANT, with special vital information for plant executives.

Name.....

Address.....

P 9-45 .....

PREFERRED UTILITIES

PREFERRED UTILITIES for Results ENGINEERED

roller plant in Ind. Sales through Link-Belt distributors will be supervised by F A Hurd, divisional sales manager, industrial distributor sales, Chicago; G H Unruh, divisional sales manager, industrial distributor sales, Philadelphia; and Harry Reisser, divisional sales manager, automotive equipment sales, Ind.

Gilbert Soler, superintendent of quality control departments at steel and tube div of **Timken Roller Bearing Co.** has been named asst general superintendent of the div.

Following transfer of George R Sommers to Pacific Coast, G Dallas Rand has been made Capitol div manager in Washington of the **Sylvania Electric Products Inc.**

William H Kerr has become associated with stoker div of **A O Smith Corp** as district representative in the Chicago market.

Midvale Co elects Richard T Nalle executive vice-president. He was also made a director of the company. While resigning as vice-president of Henry Disston & Sons, he continues as director of Disston.

National Research Corp of Boston announces opening of its Chicago branch office in Engineering Bldg at 205 W Wacker Dr. H A Hickey is Chicago district manager. E C Bowen becomes sales manager of vacuum engrg div. Frank E Penn has been promoted to chief engineer. F C Brown has been named plant engineer of Plymouth div, with mfg facilities in Florida. T W Lawler has been promoted to production manager.

Luke K Nakashian establishes consulting engrg offices at 404 Park Square Bldg, Boston, to handle process steam plants, power and oil refinery designs.

Philip O'Keefe announces his resignation as chief, conservation section, New York ordnance district, and his resumption of engineering practice as vice-president of **Byrne Associates, Inc,** utility and industrial consultants at 80 Wall St, New York 5, N. Y.

Purcell L Smith, president of **National Assn of Electric Companies,** opened the organization's Washington, D. C., office recently. Headquarters will be at 729 15th St, NW.

R E Burger has been elected president and general manager of **Ohio Public Service Co,** following resignation of T O Kennedy. At organization of board of directors, J A Strozier, a newly elected director, was also chosen a vice-president of the company.

Baltimore & Ohio Railroad Co announces appointment of Eugene J Kerr as manager of technical services.

Council of the **Institution of Mechanical Engineers** have elected to honorary membership in the Institution E G Bailey, ASME member and medalist, 1942, president of Bailey Meter Co and vice-president

AN OPPORTUNITY

to modernize your tube cleaning operations with

ROTO TUBE CLEANERS

If your tube cleaning equipment is out of date or worn beyond ordinary repair, you can now secure modern Roto Tube Cleaners directly from stock, regardless of priorities.

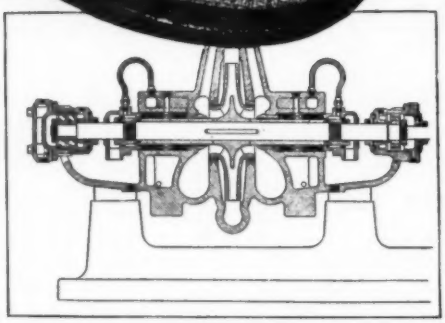
While sales to war industries, the armed forces, and Allied merchant navies are now at the highest level in our history, we are able to meet additional normal demands for Roto Tube Cleaners because of recently enlarged and improved production facilities.

With the powerful new Roto Tube Cleaner, featuring one-man operation, your tubular equipment can be maintained at top efficiency with minimum cost.

Write, wire or phone your nearest Roto representative, or contact us directly.

ROTO DIVISION of ELLIOTT COMPANY
145 Sussex Avenue, Newark 1, N. J.

HIGH *in Efficiency*...LOW *in Sleeve and Shaft Wear*



GOODALL
BRAIDED ASBESTOS
CENTRIFUGAL PUMP PACKINGS
COIL RING SPIRAL

These Goodall quality packings provide efficient low-cost service on centrifugal or rotary pumps handling hot or cold water, brine, steam, oils and some acids. Square braided from long fibre asbestos yarns, thoroughly lubricated and graphited. The method of braiding gives added resiliency, prevents hardening through carbonization, and insures minimum friction with greatly reduced sleeve and shaft wear.

Furnished in three styles, A444, Coil; A445R, Ring; A445S, Spiral. All sizes from 1/4" to 1", inclusive.

OTHER GOODALL PACKINGS AND GASKETS . . .
High and low pressure packings in all forms and compositions; plain and cloth-inserted gaskets and rings. Ask our Engineering Department for specific recommendations. No obligation.

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FACTORY—TRENTON, N. J. ***Established 1870***

of Babcock & Wilcox Co; and Jerome C Hunsaker, honorary member of ASME and head, dept of mechanical engrg, Massachusetts Institute of Technology.

Dr Henry T Heald, member of ASME, president of Illinois Institute of Technology, has been elected president of **Western Society of Engineers** for year 1945-1946. Titus G Le Clair, chief staff engineer, Commonwealth Edison Co, becomes first vice-president.

A A Potter, past president of ASME and dean of engineering, Purdue University, has been appointed acting president of **Purdue University.** He will continue as dean of engrg.

Welding Research Council of the **Engineering Foundation** has announced appointment of W Spraragen, present executive secretary of the council, to newly created position of director.

J T Rettaliata, manager of research and gas turbine development for Allis-Chalmers Mfg Co, has been named chairman of mechanical engineering dept at **Illinois Institute of Technology.**

Numerous resignations from staff of **Office of War Utilities** have taken place recently and an increasing number will be accepted as agency continues to contract in preparation for its abolishment as an autonomous war production agency this fall. F G Harriman, recently head of switchgear-transformer section of equipment production branch, left OWU some time ago to join New England Power Service Co of the New England Power Assn. E S Van Nostrand, regional power supply engineer for the Southwest and a veteran of the power div power supply section has resigned to become operating superintendent of Southwestern Public Service Co, Amarillo, Tex.

A C Fenn returns to New York office of Riley Stoker Corp. He joined **Office of War Utilities** in August, 1943, serving in boiler section of equipment production branch. Frank E Hutton, chief of boiler section during his three years with OWU, has returned to Babcock & Wilcox. Edward M Honey returns to Detroit Edison after two years with OWU. He has been chief of its steel section since last fall. Maywood Boggs, special assistant to Director Edward Falck of OWU handling labor and manpower, resigned recently. Before joining OWU in October, 1943, Boggs was international representative for West Virginia of the Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America. He will return to his organization and be stationed in Washington. E T McGrath, who has been associated with Boggs, will transfer to WPB's labor div where he will handle OWU problems.

William C Stratton, who was chief of **Office of War Utilities'** steel section and since last October special asst to chief of equipment production branch in charge of expediting steel for OWU's gas pipeline expansion program, has resigned to join design and construction dept of Ebasco

1,250,000
Pounds of Steam Per Hour
FOR PHILLIPS PETROLEUM CO.'S BORGER, TEXAS
BUTADIENE PLANT

•

Five Vogt Class VR Steam Generators

provide 1,250,000 pounds of steam each hour for the production of butadiene, so vital to America's synthetic rubber program. The steam is used directly in process and for prime mover power with exhausts for process purposes.

Photo courtesy Phillips Petroleum Co.

Send for Booklet
covering important oil and gas fired installations. Write on your letterhead.

Vogt FOR BETTER BOILERS

HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York–Chicago–Cleveland–Philadelphia–Dallas

RUST

SOUNDS

NO ALARM!

It comes in wherever air can enter, and silently starts costing you money. STOP it with Tectyl! *Not a Paint!* Easy to apply—simply spray, dip, brush or flush metal surfaces with Tectyl. Economical—a little Tectyl covers a lot of metal. Comes off quick and clean with kerosene. Protects for as long as two years, and you can *see the metal* all the time.

There is a

TECTYL

Product for every rust problem

VALVOLINE OIL COMPANY

431 Main St., Dept. 29 I, Cincinnati 2, Ohio

Refinery at Butler, Pennsylvania

General Offices, Cincinnati, Ohio

New York - Atlanta - Pittsburgh - Chicago - Detroit

Los Angeles - Vancouver, B. C. - Washington, D. C

TECTYL

STOPS RUST

Services in New York. Stratton, whose job will be taken over by J J Doyle, will continue to serve as a consultant. Howard C Barten has returned to Worthington Pump & Machinery Corp after about a year with OWU, during which he served as chief of diesel section of equipment production branch. Another Detroit Edison man, A F Griswold has returned to his company after about three years' service with equipment production branch, during which he was chief of turbine section.

F H McGraw & Co promoted Rodman B Doremus to executive vice-president and Francis J Tytus to vice-president and chief engineer. Louis B Palmer was promoted to treasurer. Also, Mr Doremus will function as president in absence of Clifford S Strike, who is now in Germany.

CURRENT AWARDS

Spence Engrg Co, Inc, Federal Telephone & Radio Corp, Proctor Electric Co, Plastic Wire & Cable Corp and **Flexitallic Gasket Co** have received the Army-Navy "E" award.

Craftsweld Equipment Corp, Radio Receptor Co, Inc and **Bowser, Inc,** were awarded third stars.

Bell & Howell Co was awarded a flag for outstanding record of employment and training of veterans of World War II. The award, first in a proposed nationwide series, was made jointly by National Assn of Personnel Directors and national organization of Disabled American Veterans.

OBITUARIES

Henry F Miller, 58, in charge of sales promotion and market research for Goulds Pumps, Inc, Seneca Falls, N. Y., died July 18 of a heart attack.

Captain Arthur Elwood Huff, Monsanto Chemical Co research chemist, was killed in Pacific on December 15.

Robert A Garrett, 49, formerly head of Garrett Engrg Co and consulting engineer for many heating concerns, died July 21 at Lowell, Mass.

J Philip O'Connell, 74, for 40 years engineer and architect at Boston City Hall, died July 18.

Thornton Lewis, past president of American Society of Heating and Ventilating Engrs, died on July 4 at age of 58.

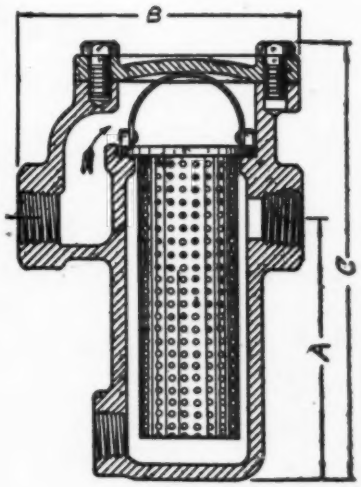
Humbert L Gaunce for many years engineer of Somerville Cream Co, died July 5 as result of an accident.

Herbert J Winn, 74, chairman of board of Taylor Instrument Co, died June 27 at his home in Rochester.

Roland R Ware, 61, president and general manager of Clarage Fan Co, died June 21 in Kalamazoo, after an illness of five weeks.

EDCO

STRAINERS



BASKET TYPE FOR VARIOUS FLUIDS

The EDCO basket type strainer is used extensively on suction and pressure pump lines carrying water, oil and other fluids.

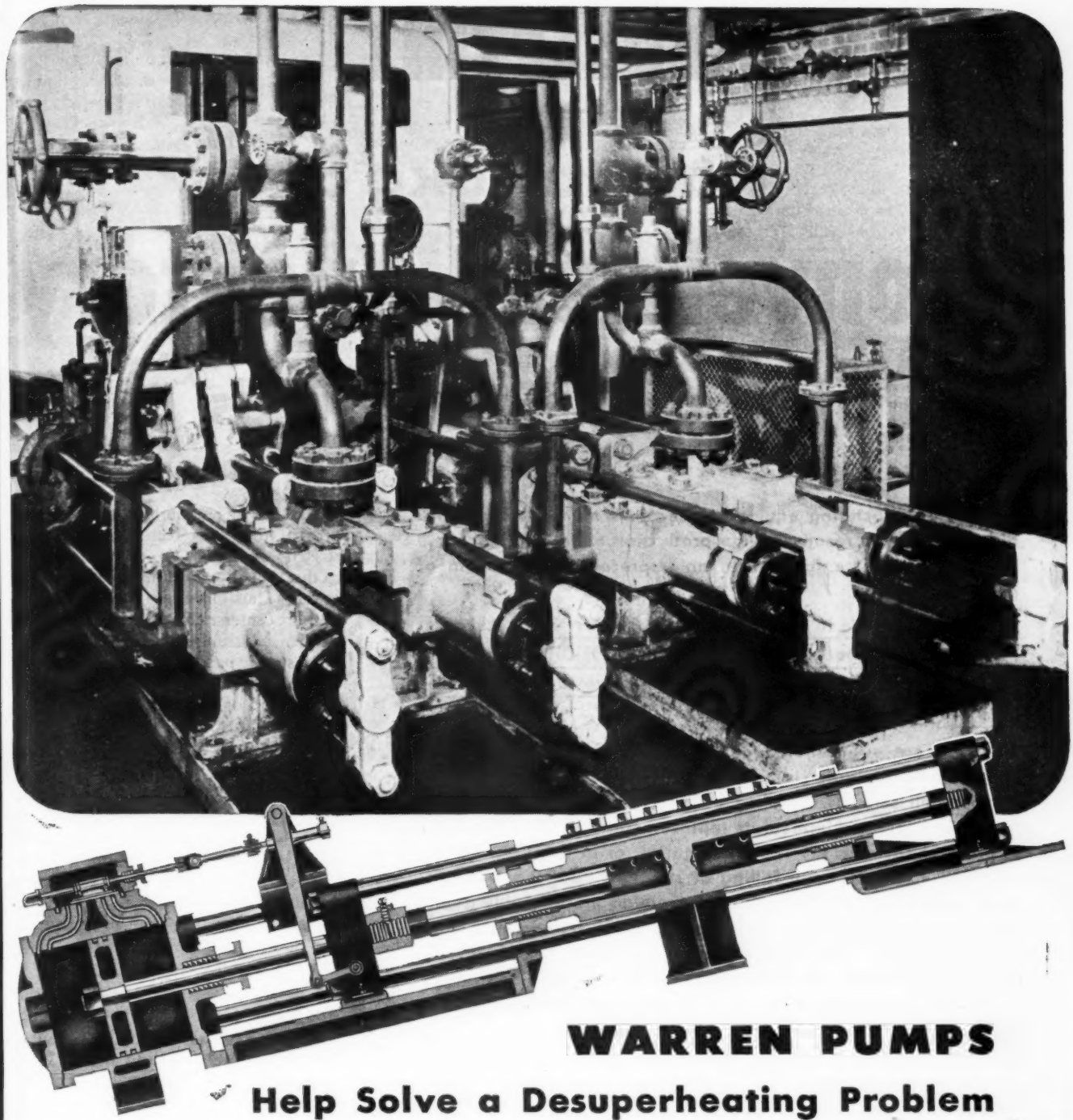
The baskets are made from either brass or steel screens or perforated sheets, depending on the nature of the operation.

EDCO Strainers are easily removed for cleaning by the handle attached to the basket. The body and cap are cast bronze but can be made from steel or semi-steel, threaded or flanged.

EDCO makes strainers for steam — air — gas and fluids. Write today for detailed data on these products. They offer you many savings. Ask for Bulletin 863.

EDDINGTON METAL SPECIALTY CO.

P. O. BOX K EDDINGTON, PA.



WARREN PUMPS

Help Solve a Desuperheating Problem

The problem was to obtain a very small variable quantity of water at a very high and constant pressure. Warren reciprocating steam pumps, with their easily controlled delivery, tolerance and pressure, furnished the solution.

In the installation shown above, steam supply varies between 1200 pounds and 900 pounds; between 615°F and 750°F. The load varies from zero to 18,000 pounds per hour.

The proper pressure and quantity of desuperheating water delivered by Warren Pumps permits the control equipment to function properly, and to maintain uniform downstream conditions of pressure and temperature at all times, irrespective of initial and load conditions.

These desuperheating pumps are located a mile away from the supervising engineers and have operated year in and year out with minimum attention and repairs. Send for descriptive folder on this type of Warren Pumps.

WARREN STEAM PUMP CO., INC.
WARREN, MASSACHUSETTS

BULLETIN!

How to Take a Reconversion Inventory of Your V-Belt Drives

☛ As manufacturing equipment becomes more widely available, and as you reconvert your production toward a peacetime basis, you may be faced with an unprecedented problem of inventory-taking.

☛ You may have to determine—more quickly than such a job has ever been done before—the EXACT CONDITION of every piece of existing equipment that you propose to use in peacetime production.

☛ Here are suggestions to speed your inventory of V-belt drives. The standards stated here will let you determine which of your *belt sets*: (1) are okay as is; (2) will shortly require replacement; (3) need immediate replacement. You should be able to place *sheaves* in the same categories, or in a fourth: (4) are obsolete . . . a common failing of sheaves, now that "Magic-Grip" and Vari-Pitch Sheaves are becoming more readily available. Or you may decide that entire *drives* belong in a fifth classification: (5) need re-engineering . . . either to correct misapplications forced by wartime shortages, or to take advantage of new developments such as Allis-Chalmers' Variable Speed Drives, with either Stationary or Motion Control.

1 START YOUR INVENTORY WITH THE RECORDS

Your records will reveal much that will be of value to you in appraising your present multiple V-belt drive equipment and in establishing its place in reconverted production.

Purchase records should show which drives have required new belts too frequently. While there's no overall rule to tell you how long a belt should last, it's safe to assume that *whenever you spot a drive* whose belts wear out *much* more rapidly than all the others, *you've found a place* where a change will save you money.

Maintenance records and *machine operating records* will reveal useful facts. Is a machine often down while belts are replaced? While sheaves are changed? Then there's room for improvement. Check trouble spots *first*. You can spot these trouble spots if you'll *start with the records*.

2 THEN CHECK DRIVE ENGINEERING

V-belt wear will be excessive — too costly for competitive peace-time operation — unless the drive is tailored to its particular power transmission job in the following respects:

Diameters—Depending on the thickness of its section, every V-belt has an "easy arc". Bend it more sharply (around a sheave of too small diameter) and the internal friction of excess flexing will cook the life out in far too short a time. In general, minimum sheave diameters for belts of given section are as follows: A—3.0"; B—5.4"; C—9.0"; D—13.0"; E—21.6".

Centers—The shorter the centers in a drive, the fewer feet of belt that can stretch—the lower the potential stretch to threaten slippage and crack-the-whip action. Thus proper engineering aims at short centers. (Short centers have the further advantage of saving valuable floor space . . . an important consideration in many factories.) In every reapplication of V-belt drives for reconverted production, remember . . . *keep centers as short as possible.*

Number and size of belts — Each V-belt is rated for horsepower; simple mathematics will tell you how many of what size you'll need for a given job. When reconverting, it's wise to *check this again* . . . the war has produced many undesirable makeshifts. Remember, though, that number and size don't tell the whole story—*speed counts too.*

Belt speed—Just as a truck's motor can pull a heavier load by traveling faster, so a set of V-belts can pull a heavier load by traveling faster. In a truck, it's a case of using a "lower" gear. In a V-belt drive, it's the same . . . using larger sheaves which have a higher rate of rim travel, thus producing higher belt speed. See the V-belt manufacturer's catalog for limits of speed recommended for any given belt.

Contact arcs—All horsepower ratings for V-belts are based on a 180 degree arc of contact with sheaves. However, this factor varies from one drive to the next—depending on its ratio and centers—and must be carefully considered in re-engineering any drive.

Tension—Each drive should be equipped with an effective tension adjustment. Belts that are too loose will slip, rub on the groove walls, heat up, and have the life cooked out of them. And when the wave curve in a loose belt whips it *tauter* across the tension

side of the drive—that belt grabs at the load, may snap. So—in checking V-belt drives for reconverted production, it's important to see to it that each set of belts has proper tension. The easiest and quickest rule-of-thumb test for proper tension is this: "A slack V-belt feels dead when you thump it with your hand; a properly taut V-belt has an alive springiness."

Alignment—Unless the shafts of the driving and driven sheaves are *parallel,* it's impossible to put *all* belts in the set at proper tension . . . and all belts run at an angle, rubbing on the groove walls, heating themselves for an early death. In reconverting for a competitive production, check parallelism of shafts . . . and check too to see that *sheave grooves* are *in line.* Out-of-line sheaves also subject belts to needless rubbing on the groove walls.

If any of your V-belt drives is notably weak in any of the above seven points, consider re-enginering the drive.

3 THEN INSPECT V-BELTS

Your inventory of working V-belts will reveal far more than just their condition; it will also show what should be done to correct existing conditions that promote V-belt wear—an important consideration in cost-conscious, competitive production. Check every belt in every set for the following tell-tale signs; note condition of belt, cause, and recommend cure.

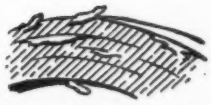
Checking these points is especially important if you're planning a *continuous* operation where belt breakage would be fatal. You can spot about-to-break belts by looking for:

SCUFFING — *Cause*: Bolts protruding inside the guard may do this. Such scuffing can exert enough "braking" to cause sudden snap and break belt.

Cure: When placing guards or steelwork near drives, anticipate some sag . . . leave enough clearance.

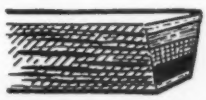
SLIP BURN — *Cause*: Belt too loose to pull its load. Belt stands still, rubbing on spinning driving sheave, heating and melting the rubber.

Cure: Keep belt taut, and sheave grooves free of oil and grease. Check machine for overload.



OIL-SWELLING *Cause*: Belt is is swelled and weakened by chemical action of oil.

Cure: Provide splash guards, or use Oil-Resisting or Oil-Proof Texrope Belts.



ABRASION — *Cause*: Abrasive dust wears the side-walls, narrowing belt width. Then belt slips, rides on bottom of groove.

Cure: Provide dust guards, keep proper tension.

4 CHECK BELT ENGINEERING

Because Allis-Chalmers belt development during wartime followed the familiar pattern of many industrial achievements—moving swiftly and outmoding many previously-acceptable types—it is *not* wise policy to replace belts by blindly ordering the same kind used in the old installation. Belts have become specialized for better economy, safety and dependability. It is time now to take a look at qualities of the new belts, and to take advantage of the special properties they have been given through use of new synthetics in their manufacture.

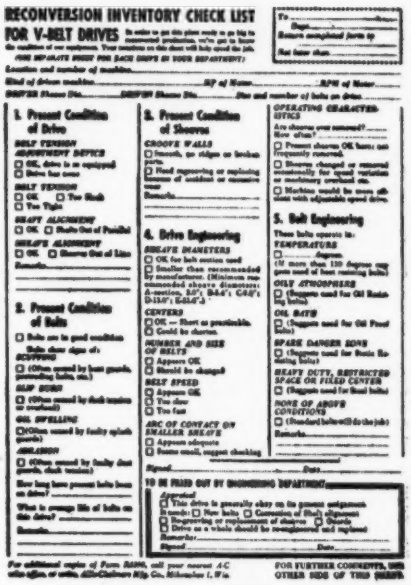
NOTE: THE MATCHED-SET PRINCIPLE —When one or two V-belts in a set are worn out or damaged, remember that the remaining V-belts have stretched beyond their original length, making it impossible to put proper tension on an old set to which *new* belts have been added. Adding new belts is therefore likely to be false economy . . . the new belts will overwork, lasting for only a fraction of their normal life. Rather than throw good money after bad, always install a complete, scientifically-matched set, storing old belts to use as replacements in other old sets.

5 INSPECT SHEAVE WALLS

For smoothness—What makes a V-belt grip the sheave? Not mere surface friction, but the *wedging* action of the bending and expanding belt. So sheave grooves may be smooth . . . *should* be smooth, to minimize belt wear. Watch out for ridges or burrs in the groove walls; if they're bad, re-groove or replace the sheave. Increased belt life will soon pay the cost.

For straightness—The sides of the V should be *straight;* if they're not, drive won't be truly efficient, belt life will be short. Some sheaves — misaligned or in hard usage — get "shoulder wear" in groove walls. Lay a straight-edge against the wall, look for a light gap. If you find hollows deeper than the thickness of a playing card, sheave needs truing.

REPLACE? OR REGROOVE? You'll have to make this decision. Note this: where small, inexpensive stock size sheaves show need for re-truing of grooves, time and trouble can often be saved by scrapping them and replacing with new sheaves. It may pay out, however, to re-groove special or large-diameter sheaves, or to return them to the factory, where a nominal charge is made for this service.



RECONVERSION INVENTORY CHECK LIST FOR V-BELT DRIVES

Ask A-C for sample copies of this V-Belt Drive Inventory Check List.

CENTRIFUGAL PUMPS, ELECTRIC MOTORS NEED INVENTORY TOO!

All three of these common industrial units — V-belt drives, centrifugal pumps, and electric motors — are covered in Allis-Chalmers' new *Reconversion Inventory Kit.* No big package, this Kit is simply a set of Fact Sheets and Check Lists, with suggestions for Inventory procedure as outlined on these pages but in slightly more detail.

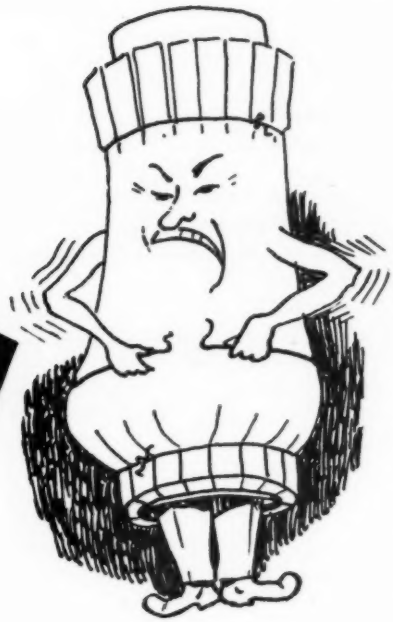
A 1884

GET THESE FREE FORMS!

For your supply of Reconversion Inventory Kits, covering V-belt drives, centrifugal pumps, and motors, call your nearest Allis-Chalmers district office or distributor, or write Department 111, ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

ALLIS CHALMERS

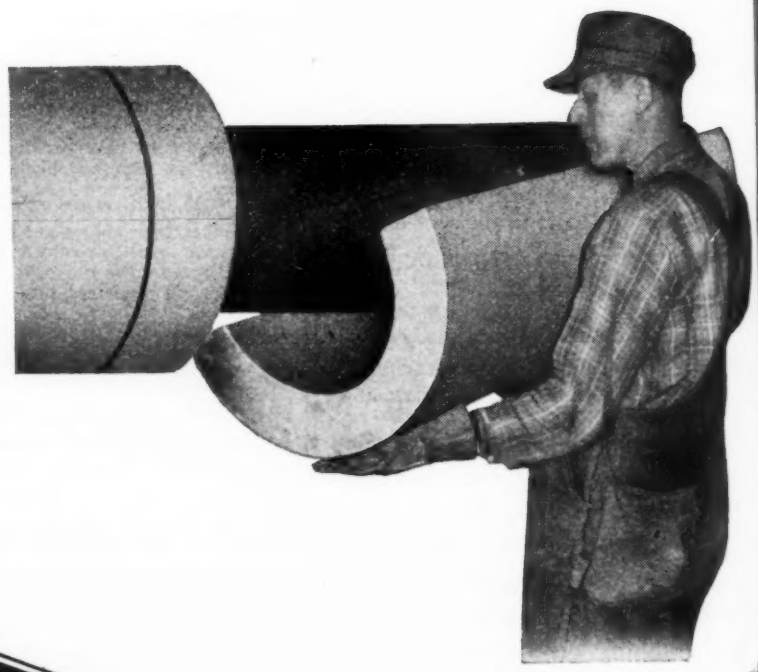
TROUBLED BY "MIDDLE-AGE SPREAD"?



SIMPLY APPLY UNIBESTOS
it's simple to apply!

Unibestos, the sectional insulation, will not dent, shatter, sag or gap as the result of vibration, exposure to moisture or hard knocks. This greater structural strength is a result of Unibestos' resilient, tough fibrous construction.

Unibestos is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5". Single layer construction is available for service up to 1200°.



UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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UNION ASBESTOS AND RUBBER CO

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
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UNION ASBESTOS

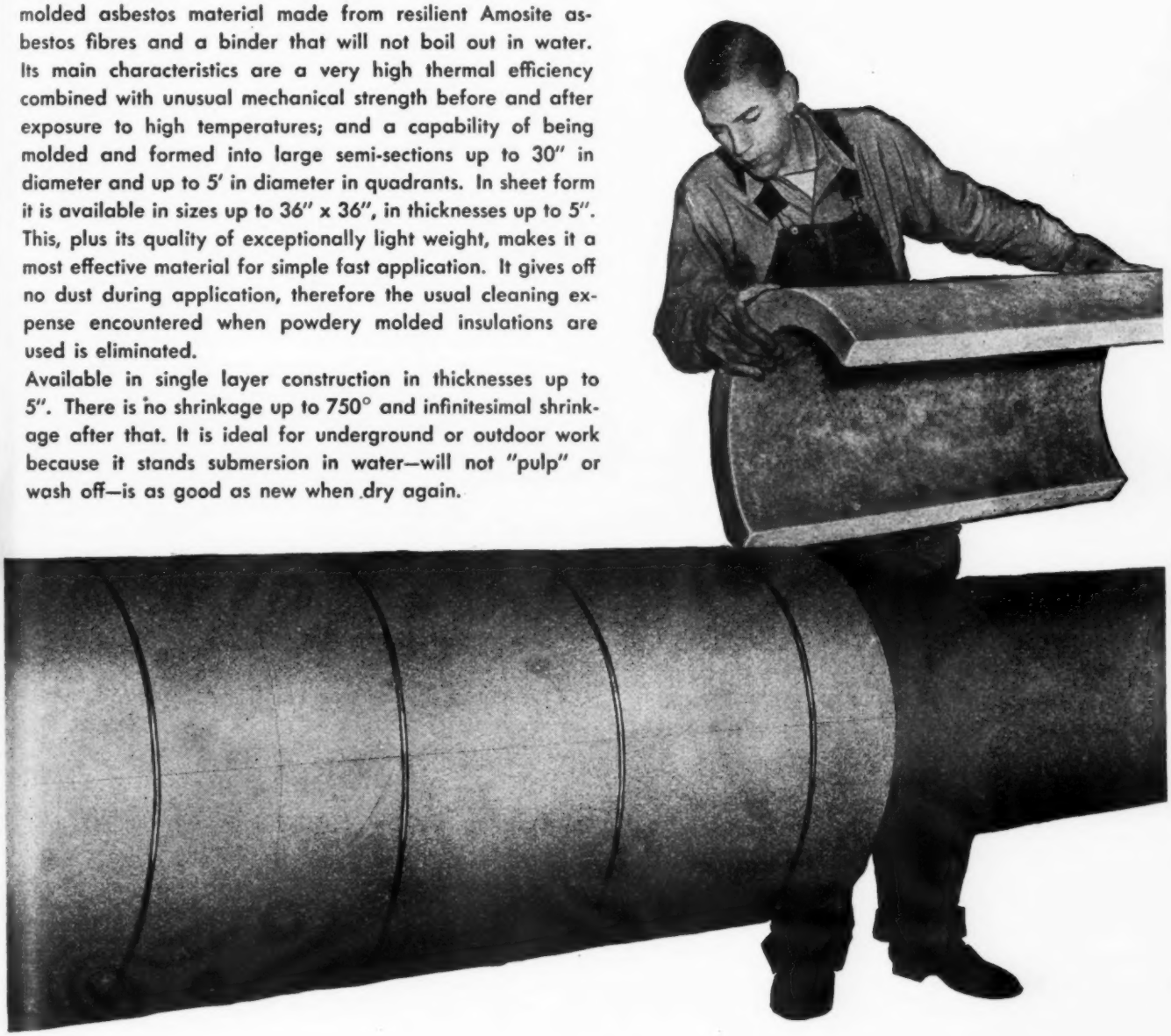
MEANS PROGRESS IN INSULATION AND PACKING

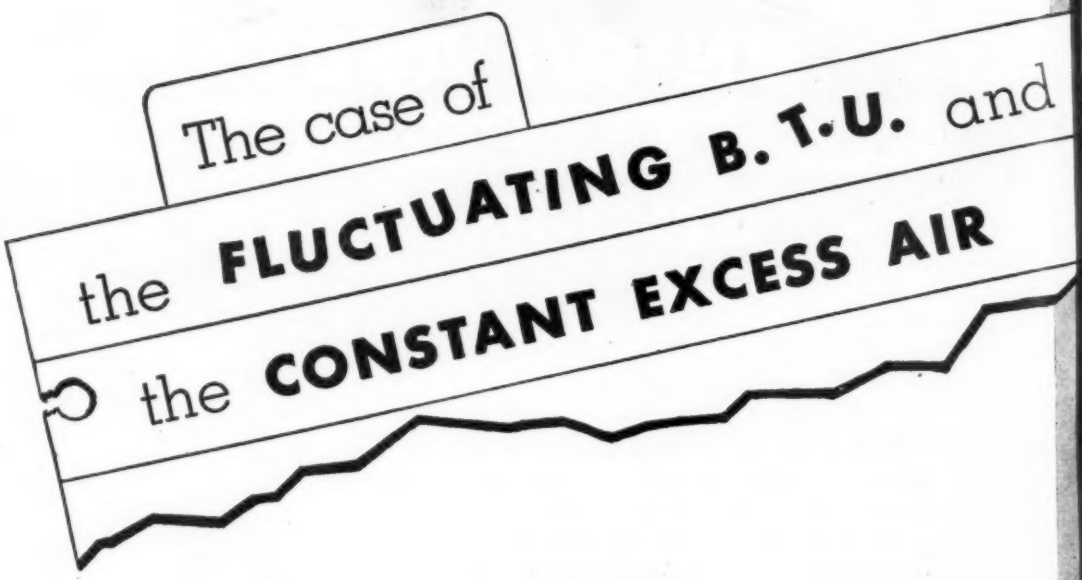
AND RUBBER CO.

UNIBESTOS INSULATION

Unibestos insulation in sectional block and sheet form is a molded asbestos material made from resilient Amosite asbestos fibres and a binder that will not boil out in water. Its main characteristics are a very high thermal efficiency combined with unusual mechanical strength before and after exposure to high temperatures; and a capability of being molded and formed into large semi-sections up to 30" in diameter and up to 5' in diameter in quadrants. In sheet form it is available in sizes up to 36" x 36", in thicknesses up to 5". This, plus its quality of exceptionally light weight, makes it a most effective material for simple fast application. It gives off no dust during application, therefore the usual cleaning expense encountered when powdery molded insulations are used is eliminated.

Available in single layer construction in thicknesses up to 5". There is no shrinkage up to 750° and infinitesimal shrinkage after that. It is ideal for underground or outdoor work because it stands submersion in water—will not "pulp" or wash off—is as good as new when dry again.





For three years, the new boiler worked perfectly. Its rated capacity was 400,000 pounds per hour at 825 p.s.i. Two 12-ton per hour pulverizers supplied the fuel, and Hagan Automatic Combustion Control maintained proper steam pressure, furnace draft, and fuel-air ratio.

Throughout this period the plant had an assured supply of 13,000 B.t.u. coal, but early in the war it became necessary to supplement this with 10,000 B.t.u. coal from a nearby stripping operation.

Both types of coal might be in the hopper at the same time. The supply to the pulverizers at any moment might be either fuel, or any mixture of the two.

With a control system in which air supply is governed by rate of fuel feed, this might have been a serious matter, but with the Hagan Differential Master method it was no problem at all.

With this system the steam header Master Sender maintains heat input always equal to load demand, and the *Differential* Master Sender utilizes the boiler itself as a calorimeter of heat input to control air flow. Air is controlled in a positive, *direct* manner, not as an after correction.

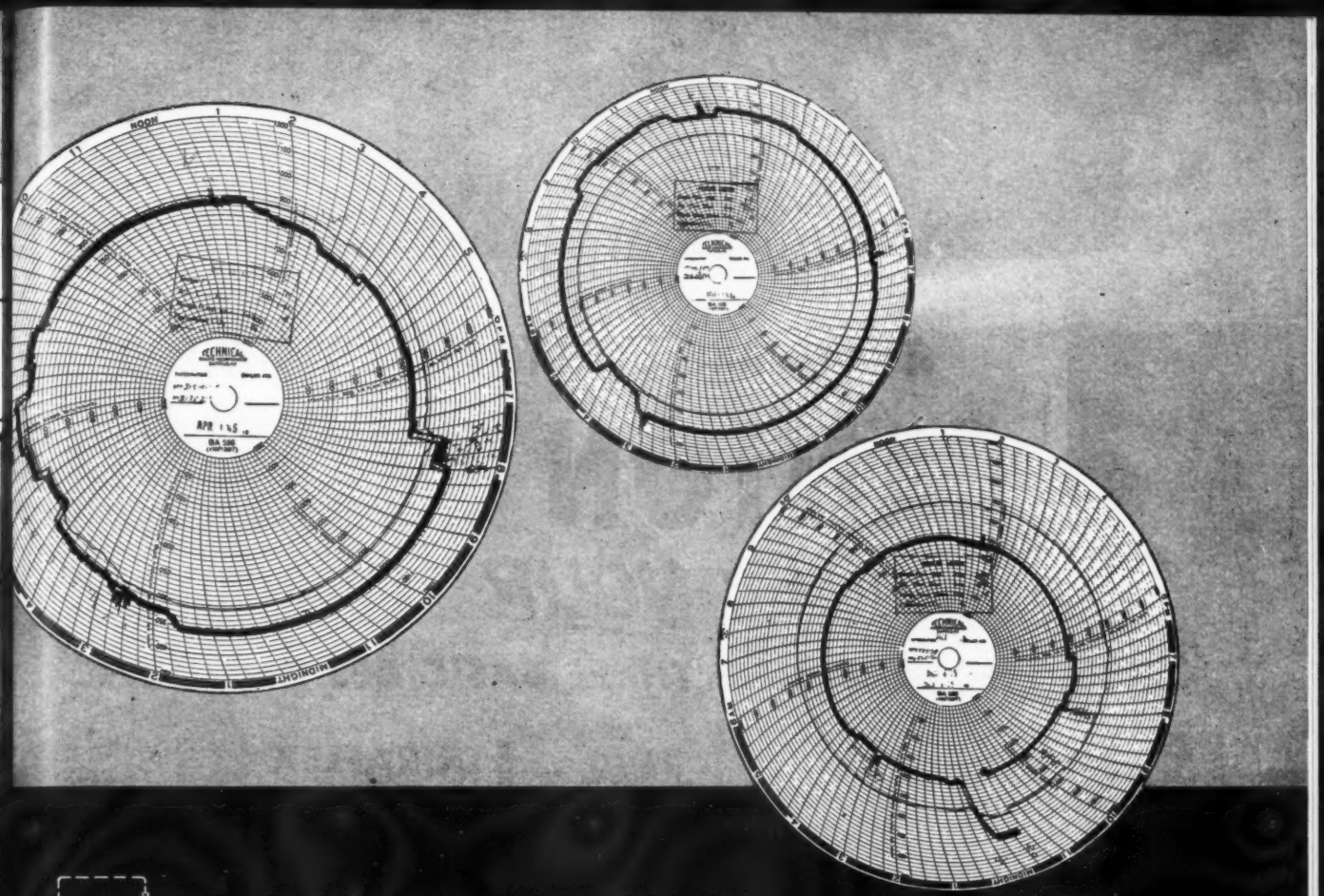
In the past three years, the Hagan Differential Master method has been successfully applied to boilers burning oil, gas, and pulverized coal, and ranging in size from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1800 p.s.i.

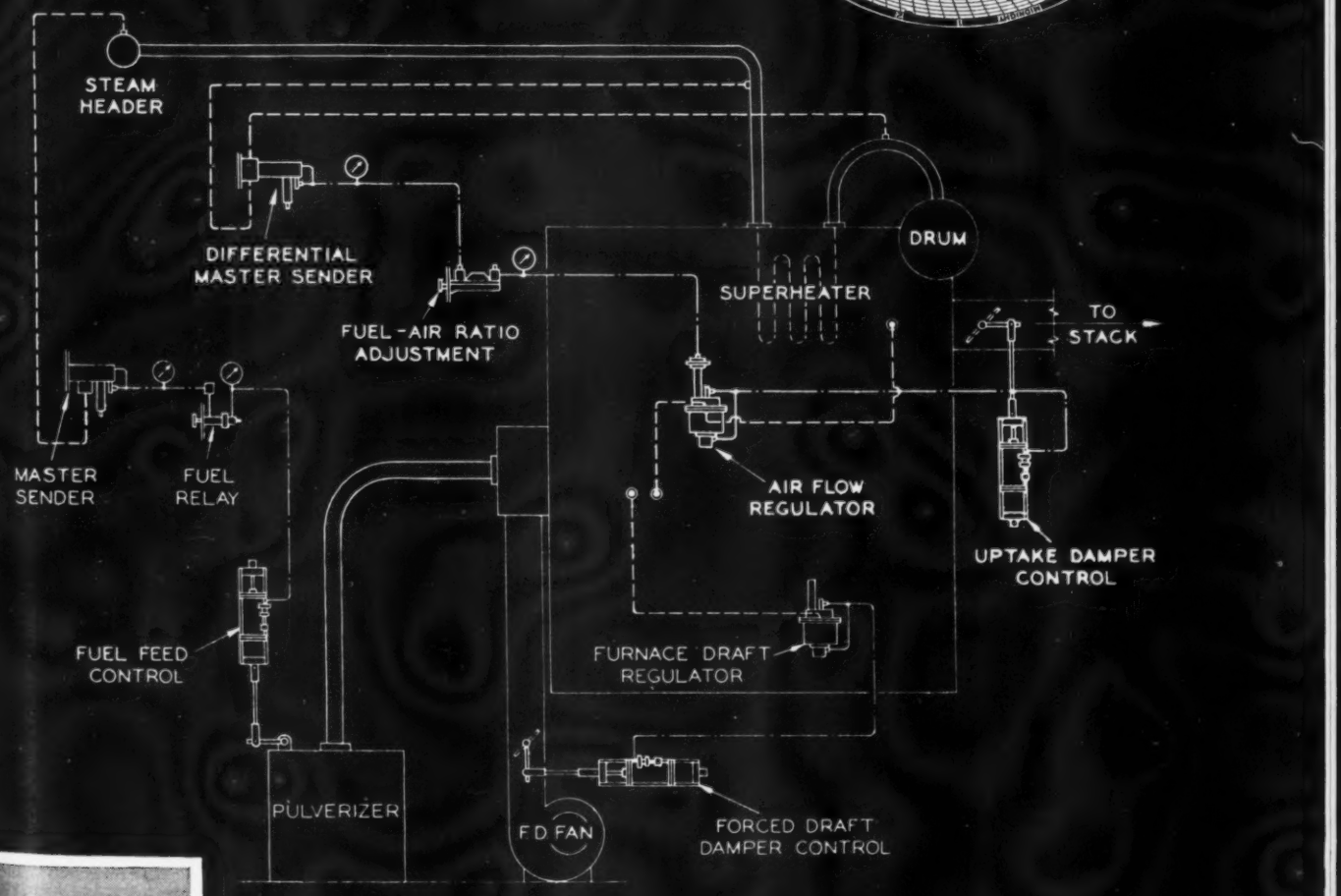
Our engineers will be glad to supply full information.

HAGAN CORPORATION, Hagan Building, Pittsburgh 30, Pa.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

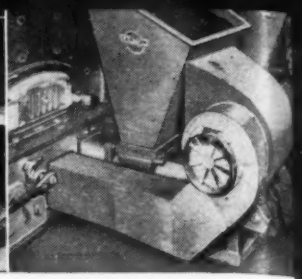




HAGAN
HALL
BUROMIN
CALGON

COPPERWELD STEEL CORP., WARREN, OHIO

ISALY DAIRY, NEW WILMINGTON, PA.



EUCLID ROAD MACHINERY CORP., CLE

U. S. NAVAL AIR FACILITIES, COLUMBUS, O

MORIN HEIGHTS HOUSING PROJECT, WOONSOCKET, R. I.

GRIFFIN MANUFACTURING CO., BROOKLYN, N. Y.

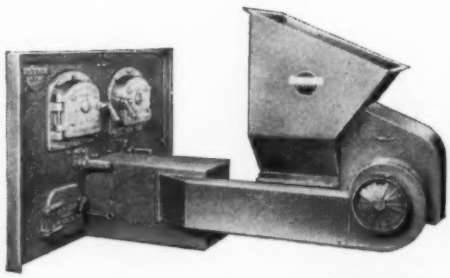
E & W DYEING CORP

THERE ARE 54 TYPES AND SIZES OF

CANTON STOKERS

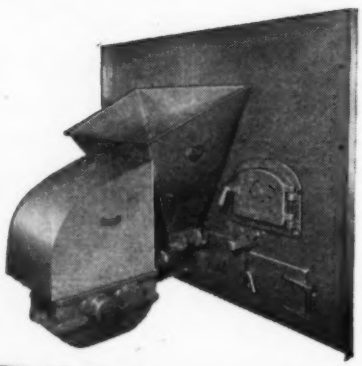
TO MEET *YOUR* REQUIREMENTS

HERE ARE THE THREE BASIC DESIGNS . . .



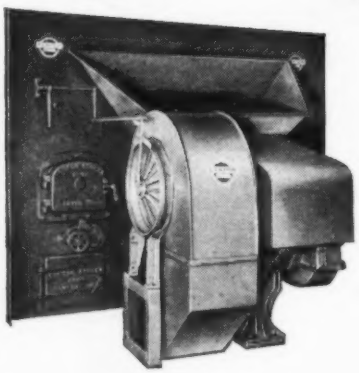
DURAFLEX

A wormfeed stoker for industrial and commercial installations with many features usually found only on ramfeed designs. Especially adapted to boilers developing up to 175 H.P., the Duraflex includes the refinements of a large active grate area, side ash dumping plates and zoned windbox. Separate fan drives and full furnace fronts are standard auxiliaries always available. Write for Bulletin No. 500.



LO-SET

A compactly designed Heavy Duty Ramfeed stoker that has saved expensive furnace alterations and pitting for installation on scores of jobs. Built with a safety factor of 5 to 1 for developed loads of 450 H.P., the LO-SET will easily carry over-ratings up to 200%. Hi-Firebox heating and power boilers, designed to avoid furnace refractory, are successfully fitted with Canton Lo-Set Stokers. With Canton Synchronized Combustion Control, this unit will swing from 50% to 200% of boiler rating without manual attention. Request Bulletin No. 400.

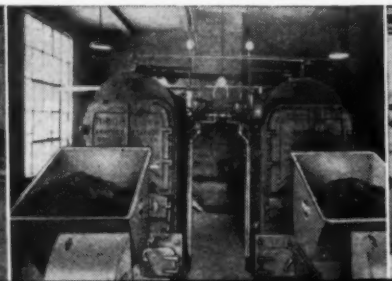


VULCAN

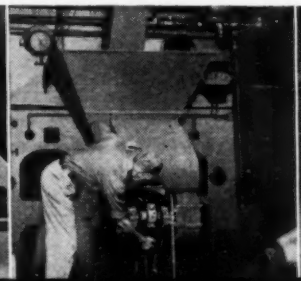
All Custom Built, these Stokers carry the heaviest industrial loads in continuous duty service. On either electric or steam drives they develop 800 H.P. or more, and with Canton Synchronized Combustion Control require no manual attention in shifting from 50% to 200% of rating. An extremely rugged, dust-proof gear box drives the Stoker through oversize bearings, gears, and sprockets with a safety factor of 5 to 1. Wearing surfaces are alloy-hardened and many parts are practically indestructible. Full information is offered in Bulletin No. 200.

PATERSON, N. J.

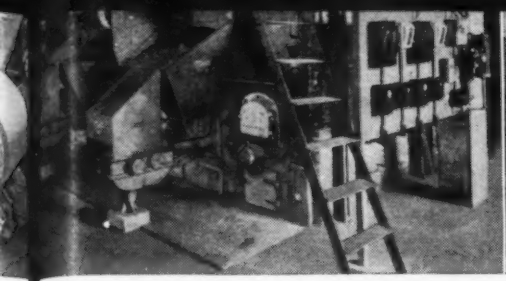
FERRO-ENAMEL CORP., CLEVELAND



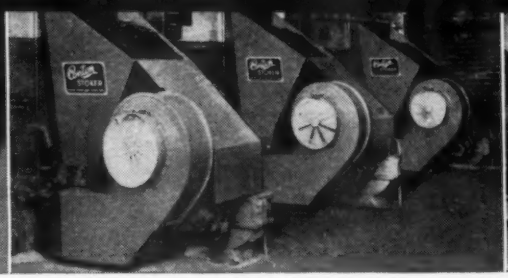
PAGE LAUNDRY, WASHINGTON, D. C.



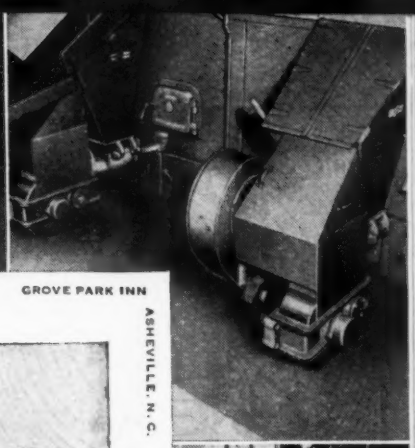
GESU CHURCH, CLEVELAND, OHIO



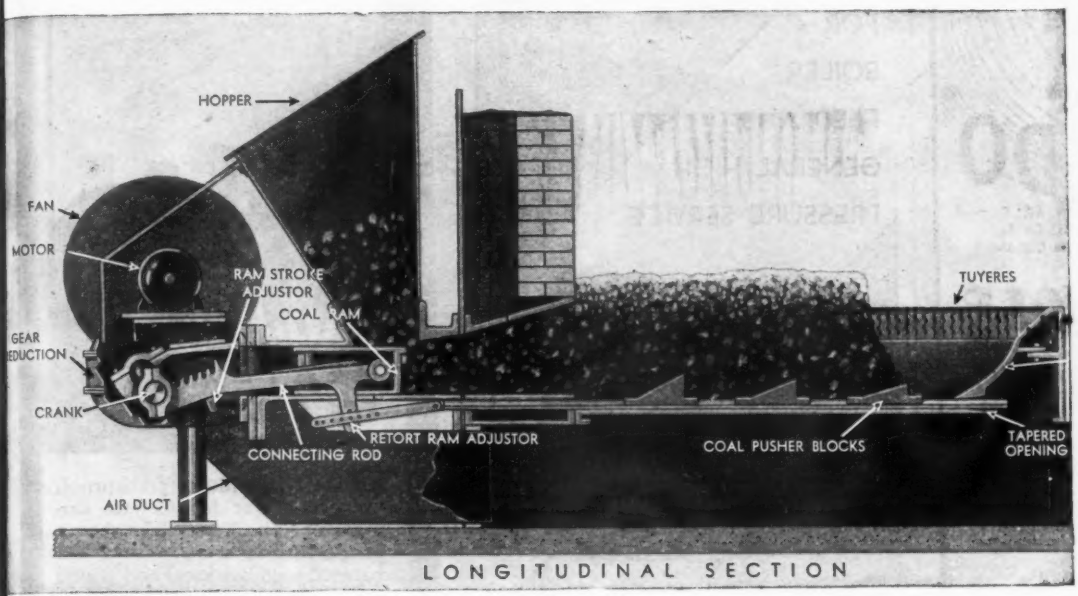
NORTON AND COMPANY, ALEXANDRIA, VIRGINIA



GENERAL HOSIERY COMPANY, FT. WAYNE, IND.

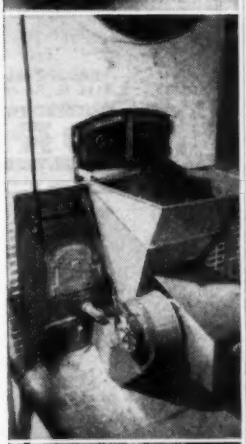


GROVE PARK INN
ASHEVILLE, N. C.

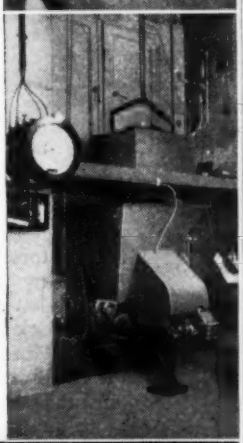


LONGITUDINAL SECTION

NEWBURGH AND SOUTH SHORE RAILWAY



VICTOR SILK HOSIERY, NEW BRITAIN, PENNA.

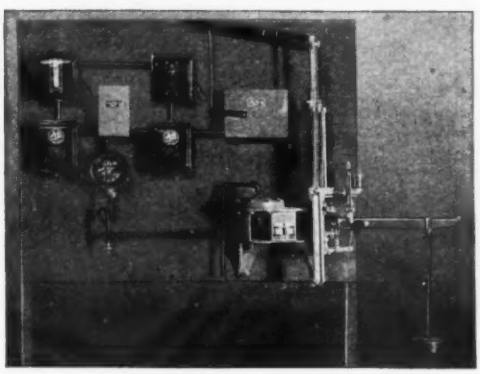


SHOREHAM HOTEL, WASHINGTON, D. C.

IS X-RAY VIEW OF THE CANTON VULCAN STOKER *gives the inside facts on the simplified, powerful mechanism. Coal is loaded into V-shaped Hopper by hand or conveyor system, and falls by gravity down to Coal Ram. The Coal Ram is driven in a reciprocating action by the Crank, allowing coal to fall in front of Coal Ram on back stroke, and pushing it into Furnace on forward stroke. The highly efficient mounting of motor and gears delivers maximum power to the Coal Ram, which easily crushes wood, slate, and small pieces of foreign matter, feeds them into Furnace, and thus eliminates usual causes for stoppage. After passing through Throat, coal is distributed and levelled over the entire area of the Furnace by a Retort Ram with Pusher Blocks, adjustable for any kind or size of coal.*

CANTON STOKERS SAY IT WITH SERVICE—AND BACK IT UP WITH A FIVE YEAR GUARANTEE

CANTON STOKERS



Synchronized Combustion Controls-- For automatically varying coal feed, forced draft and boiler draft to follow efficiently steam demand.

All working parts not exposed to the fire are covered by a five year guarantee applying not only to defects, but actually wear itself. Only because these Stokers are built stronger at vital points, from superior materials, do they merit such a guarantee. A corps of travelling service engineers assists and advises Canton Stoker owners in securing best results.

Now IMMEDIATE DELIVERY FROM STOCK

TO REPLACE OIL, GAS, OR HAND FIRING EQUIPMENT

Send for Descriptive Literature and Cost Saving Facts

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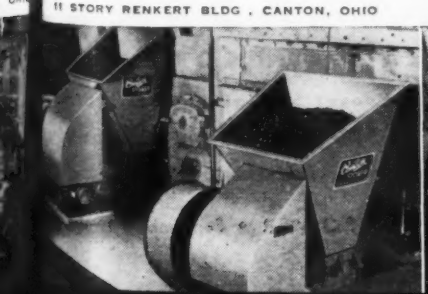
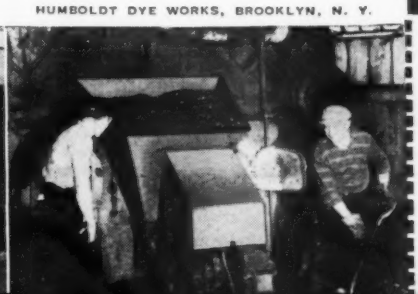
HUMBOLDT DYE WORKS, BROOKLYN, N. Y.





CANTON STOKER CORPORATIO

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---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediate

Name ----------

Company ----------

Address ----------

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PORTABLE INDUSTRIAL VACUUM CLEANER

reduces **DUST DANGER**

QUICKLY cleans walls, floors, line shafting, pipes, overhead beams, etc. Reduces health and fire hazards. Improves working conditions and morale. Cuts waste. Salvages valuable scrap. Increases efficiency.

A real one-man unit. Weighs only 40 lbs. 1 H.P. Universal motor. 49" waterlift, 175 c.f.m. Removes dust, chips, lint, etc. Does a thorough cleaning job. Attachments for cleaning everything.

Convertible into Blower for blowing dust and dirt out of motors, generators and hard-to-reach places. Adaptable for spraying paint and insecticide.

Free Trial—Write to

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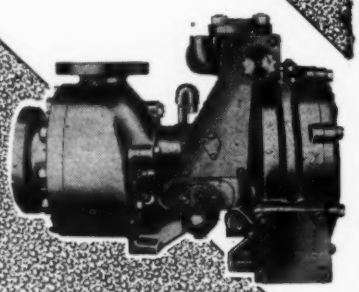
TAKE THE DUST OUT OF INDUSTRY **TORNADO**

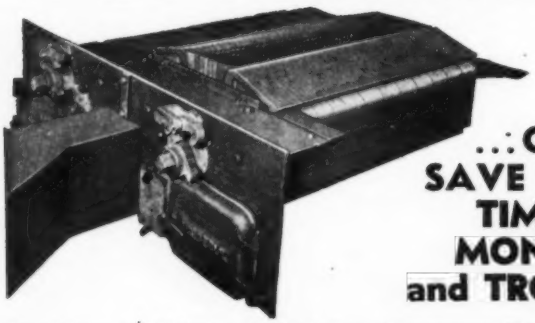
COFFIN TURBO PUMPS

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



THE J. S. COFFIN, JR., CO.
ENGLEWOOD, NEW JERSEY

THE FREDERICK STOKER WITH *FULLY* ACTIVE GRATE SURFACE



. . . CAN SAVE YOU TIME, MONEY and TROUBLE

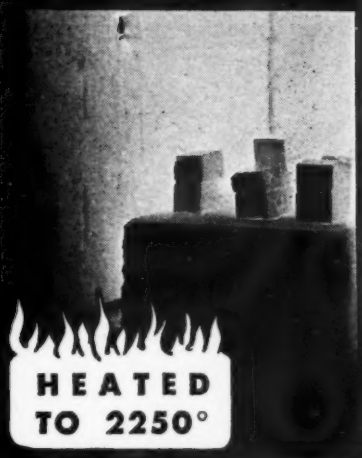
Operators of Hotels, Institutions, Apartment Houses, etc., economy minded but thoughtful of the comfort of their clientele, can get *more* heat and burn *less* coal with a Frederick Stoker. The Frederick requires very little attention. More grate area . . . maximum combustion and full utilization of heat giving gasses, produces the highest number of heat units from every pound of coal consumed. Engineering consultation available without obligation.

Frederick also manufactures fine Centrifugal Pumps . . . guaranteed to do the work for which they are sold.

THE *Frederick* IRON & STEEL CO.
Frederick, Maryland

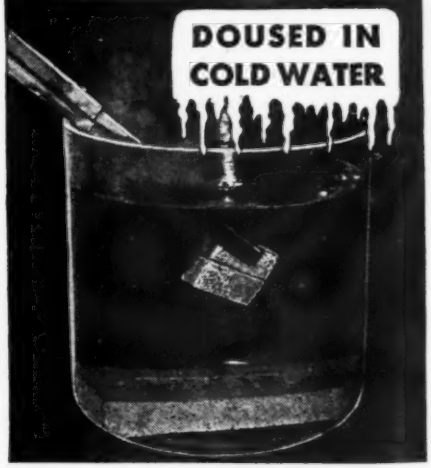
STOKER SPECIALISTS SINCE 1918

Demonstrating BRICKSEAL REFRACTORY COATING



Brickseal provides a crackproof, vitrified armor for furnace linings. The small firebricks shown in the furnace were bonded and painted with Brickseal and heated to 2250°. Directly from the furnace they were plunged into cold water as shown below—a test for *any* material subject to expansion and contraction.

Brickseal is *semi-plastic when hot,* yet *hard and tough when cold.* Brickseal is made in grades suitable to heats ranging from 1400° to more than 3000°. It will make any furnace last longer by giving new life to your refractories. Write or call local dealer for a demonstration.

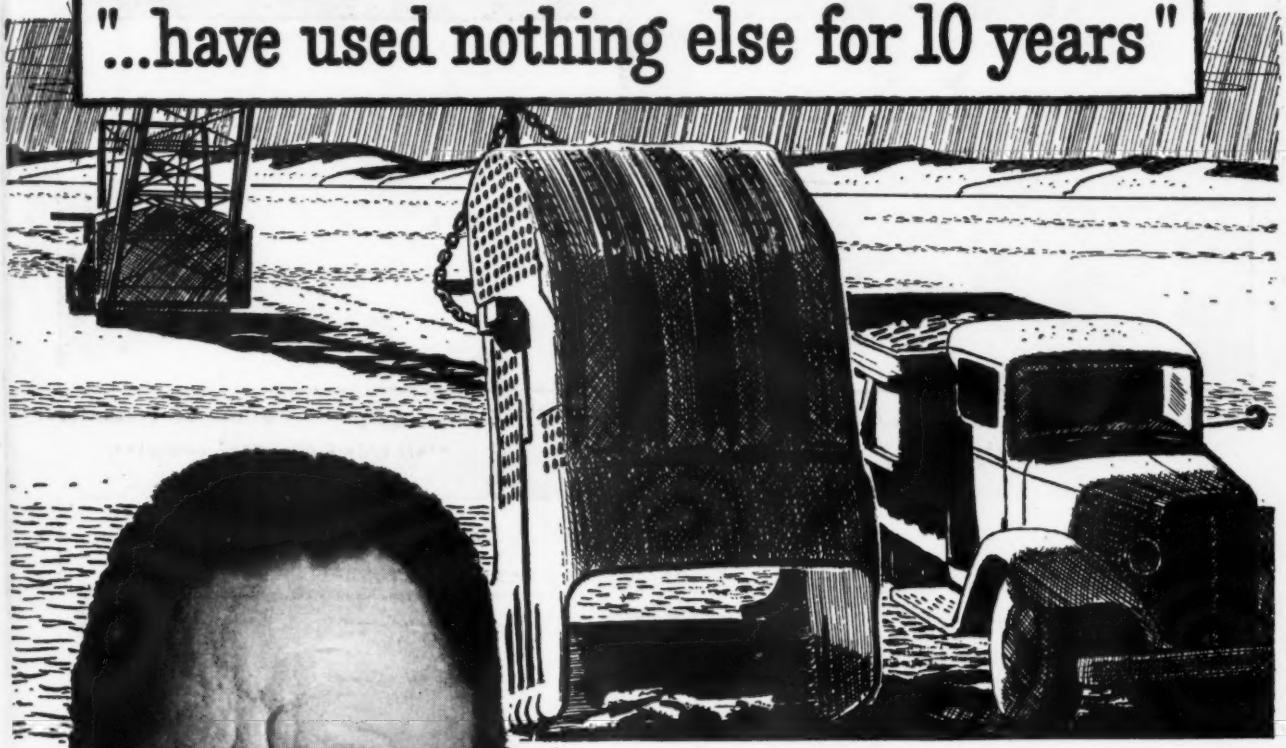


BRICKSEAL

REFRACTORY COMPANY

5800 S. Hoover St., Los Angeles, Cal.
1029 Clinton St., Hoboken, N. J.

"...have used nothing else for 10 years"



FROM LOUISIANA

EDWARD SWAN; General Manager
Walter P. Villere, General Contractor
New Orleans, Louisiana

One of a series of testimonial letters received from all parts of the United States

"...our company uses in the construction business one of the largest draglines in the South, a Walking Monagan, capable of handling 10 cubic yards of dirt at a time.

...machine which is now working on an emergency levee building job on the Mississippi River at Baton Rouge, is powered by a Fairbanks Diesel motor.

...as you know, a Diesel motor operates faster, and under increased pressure of heat, ordinary oils form carbons and plug up piston rings...power and compression are cut to an alarming extent.

...ten years ago Macmillan Ring-Free Motor Oil was recommended as a solution to the problem of keeping machine in prime working order...we have used nothing else since.

...having been around machinery all my life, have yet to see any other motor oil accomplish in both Diesel and gasoline motors what Macmillan Ring-Free can do."

Excerpts of letter from— Edmund Swan

Other equipment operated by Villere Company: two P. H. Shovels, 1¼ yard capacity with Waukesha motors; four 1½-Ton Ford Trucks, one 1½-Ton International, one 1-Ton Diamond T; 1940 Imperial Chrysler, 1942 Oldsmobile, 1936 Chrysler, 1941 Plymouth. On Macmillan Ring-Free, of course!

MACMILLAN RING-FREE MOTOR OIL

Operators of all types of equipment report lower-cost, more efficient performance with Macmillan Ring-Free Motor Oil. Find out how it can help lick your toughest lubrication problems... Phone or write the nearest Macmillan office.

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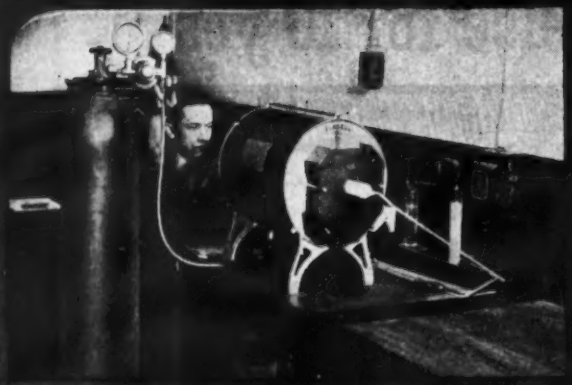

Test for determining the [illegible] of carbon in steel [illegible]

Spectrometer [illegible] of essential [illegible] steel samples.

M
KELLOGG
W

Rockwell testing machine for determining the hardness of metals.

Zeiss metallurgical photomicrographic apparatus capable of magnifying 2500 times.

With KELLOGG PIPING
Bugs are licked in the Laboratory before the Plant is Built!

Through super-sensitive apparatus measuring load deflections to one millionth of an inch, exact results are secured by The M. W. Kellogg Company in solving complicated design problems of high temperature and high pressure piping.

To assure selection of the correct steel, carbon or alloy pipe to meet varying operating conditions, Kellogg maintains a program of continuous research and tests. Chemists, metallurgists and process engineers work closely with the mechanical engineers. The result is a correctly designed and fabricated installation that will render long and satisfactory service.

On your next difficult piping job, consult KELLOGG.

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FAIRFIELD

DESIGNS THE SYSTEM TO MEET THE NEED

★

Gravity feed to stoker and silo with chute for outside storage

Illustrated above is a gravity coal feed from Silo direct to stokers by means of chutes. Drip and sift-proof gates near the top of the chutes govern feed of coal to stokers.

At the left are shown Fairfield Coal and Ash silos. The coal elevator is equipped with a chute for discharging coal to outside stock pile and ash silo is arranged for easy disposal into trucks.

As is customary with all Fairfield installations the equipment is designed to meet the customer's requirements.

The Fairfield Organization specializes in designing—building—and erecting coal and ash handling systems. There is but one responsibility for entire equipment and installation. If you are interested in modern, efficient coal and ash handling you can get it at Fairfield.

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Builders of Coal and Ash Handling Equipment

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TYPE WB BRAKE

Solves the A-C BRAKE Problem

....gives better PERFORMANCE too...

Rectifier - Unit in compact form for separate mounting on existing installations.

MANY users of a.c. motor-driven cranes, hoists and machinery are switching to the EC&M Type WB Brake with rectifier-unit. Its *high-speed performance* and *reduced up-keep* for a.c. circuits have prompted its nationwide acceptance. Repeat orders indicate standardization on the WB Brake wherever a.c. brakes are needed.

These brakes not only eliminate the laminated members required in a.c. brake design, but give quick response. High initial current insures *fast release;* automatic reduction of the holding current results in *fast setting*.

The rectifier-unit is compact and is arranged for separate mounting for existing installations. On new projects, it may be combined with the motor control panel. Bulletin 1006 gives complete details on WB Brakes for- a.c. operation. Bulletin 1004-D describes them for d.c. service.

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because

No laminated magnets or plungers.
No destructive hammer-blow.
No a.c. chatter.
No coil burn-out due to shoe-wear affecting air-gap.
No motors, gears or pumps.
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Has ability to permit accurate inching.
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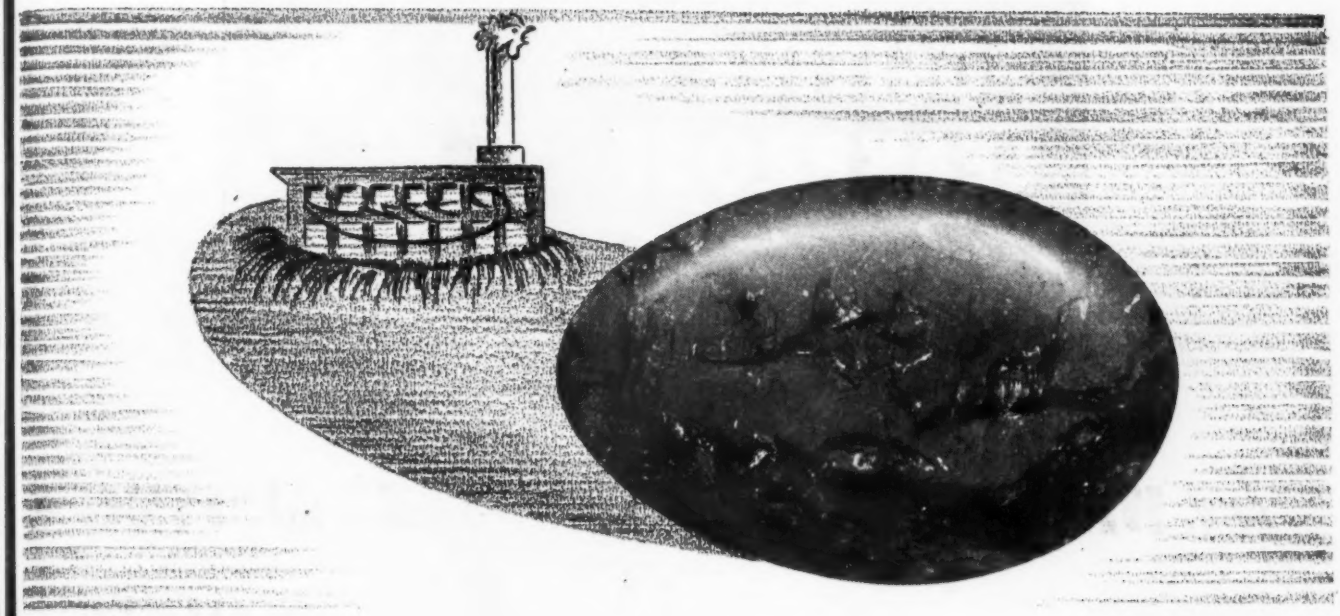
Has solid cast-steel magnet and armature.
Has short armature-movement.
Has thick, molded brake blocks 1/4" to 3/4" thick.

On Cranes, Hoists and Machinery ...the EC&M Type WB Brakes *give* HIGH SPEED PERFORMANCE —REDUCED UP-KEEP



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To put "first things first" with a new power plant means to make a complete fuel investigation before *any* conclusions are reached as to how the plant is to be built.

The first step involves full data on the competitive costs of the coals economically available to the plant.

Step number two is the design of the plant itself to insure flexibility and trouble-free operation on a sufficiently wide range of coal quality so that the equipment will never be restricted to any particular coal or one with limited reserves.

Equipment manufacturers and the Fairmont Coal Bureau are prepared to offer recommendations to enable you to "put first things first" in new plant construction or modernization to assure a competitive steam-generating cost far into the future on *available* coals.

Include Low Fusion Fairmont Coal in Your Fuel Investigation

- . . . . . **it can be burned economically in any equipment properly engineered for its use**
- . . . . . **huge reserves extend its availability for many years to come**
- . . . . . **it represents an outstanding value on a Btu basis.**
- . . . . . **engineering to use FAIRMONT COAL assures the lowest overall steam cost for the life of the plant.**

Up-to-the-minute data on coal and its relation to steam plant design are available in "Reference Bulletins" which will be sent promptly on request. Ask to be placed on our mailing list. Use coupon below.

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for DIESEL ENGINE STARTING—

& OTHER DIESEL SERVICES

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OPERATES ON VARIOUS TYPES OF REMOTE CONTROL SYSTEMS SUCH AS—

★ *ELECTRIC*

★ *DIRECT PNEUMATIC*

★ *INDIRECT HYDRA-PNEUMATIC*

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● Maximum flexibility of control is provided by Grove Flexflo Valves in the operation of large and smaller Diesel Engines. On Diesel starting, air is normally supplied instantly upon demand, but the Flexflo Valve is readily adjustable for retarded-opening in accordance with existing requirements. Being fully self-operating and utilizing *NO METALLIC* moving parts. This Expansible tube type valve delivers smooth, non-turbulent flow at capacities greatly in excess of conventional globe and other types of valves. Positive bubble-tight shut-off precludes the loss of air, fluids or gas. Remote operation is effected by any standard medium. Investigate fully, today.

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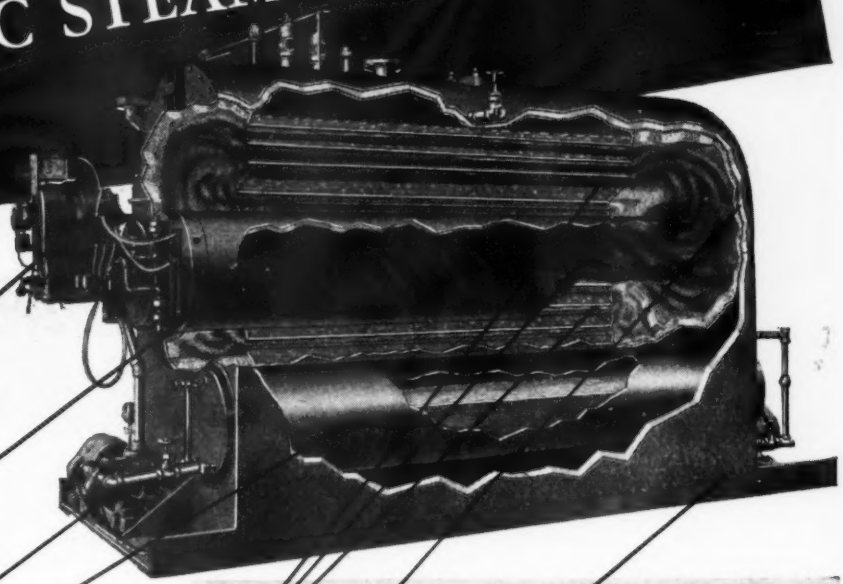
BUYING A STEAM GENERATOR?

AUTOMATIC STEAM GENERATOR



No other steam generator gives you such a great combination of engineered features all in one automatically operated, self-contained unit — you can depend on the Econotherm for outstanding economy, efficiency, long-life and cleanliness. The result of 65 years experience!

AUTOMATIC OPERATION: Every instrument and control necessary for fully automatic operation with minimum supervision.

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★ ROTARY COMBUSTION: An exclusive Dutton principle gives greatly increased firing rate and quicker steaming to meet maximum demands instantly.

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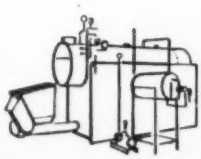
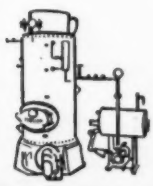
HIGH PRESSURE BOILERS



Dutton



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PRESSURE VESSELS • HEAT EXCHANGERS • CONDENSERS

THE C. H. DUTTON COMPANY • 622 GIBSON STREET • KALAMAZOO, MICHIGAN

★ *A few months ago we pictured in this publication a heavy-wall tee with a remarkably long outlet—so long in fact that a few of our friends were a little skeptical and implied that we had perhaps over-extended our poetic license, as well as the outlet, in retouching the photo.*

Well . . . this one, as you can plainly see, is not retouched. The tee was photographed before machining just to show what can be done with hot metal if you know how.

YES, "*if you know how.*" . . . And it will pay you to keep this matter of "know-how" in mind when you choose standard welding fittings. The need for unusual knowledge and highly specialized skills may be less apparent in regular fittings than in specials like this, but make no mistake: it is *no less essential.*

That is why we have cited this and many other unusual jobs which testify so eloquently to the "know-how" of Taylor Forge. This knowledge has enabled us to put into WeldELLS and other Taylor Forge welding fittings every feature wanted by everyone from the pipe designer to the welder.

In fact, you will see the evidences of this in every WeldELL . . . in the strength features like the selective distribution of extra metal where strains are greatest . . . in the convenience features like the tangents, the quarter-marked ends, the machine-tool bevels, the extremely accurate dimensions. Indeed, you will see that

WeldELLS have everything

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

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Montreal 20, Canada	5575 Cote Saint Paul Road
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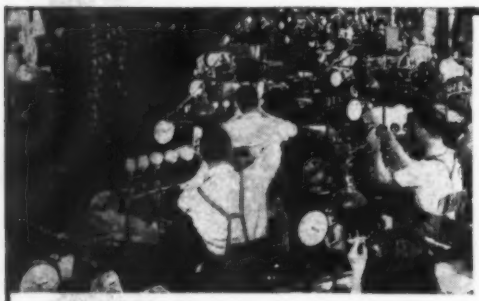
She's the Clock-Watcher Type—*Intentionally!*

ONE OF THE REASONS 6 OUT OF 10 PICK U. S. GAUGES



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Gauges are adjusted and spot-tested at various points, many at a clip, on a special manifold. This is only one of numerous tests.

6 OUT OF 10 ARE U. S. CUSTOMERS

Six out of ten original equipment manufacturers using pressure and vacuum gauges specify U. S. This is no happenstance. Buyers' preference stems from U. S. *Manufacturing Control*, the watchdog of all U. S. manufacturing operations from raw material buying through calibration (the step we show you this month) to final inspection and shipment.

US Gauges

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Printing of the new U. S. Gauge catalog has not quite been completed but place your reservation with us for a copy now. As soon as the presses stop we will start mailing copies to the hundreds of inquirers. This catalog has over 100 pages on gauges and gauge manufacture. Easy-finding index. Special easy-ordering guide. Request on business letterhead, please.

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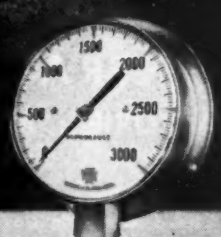

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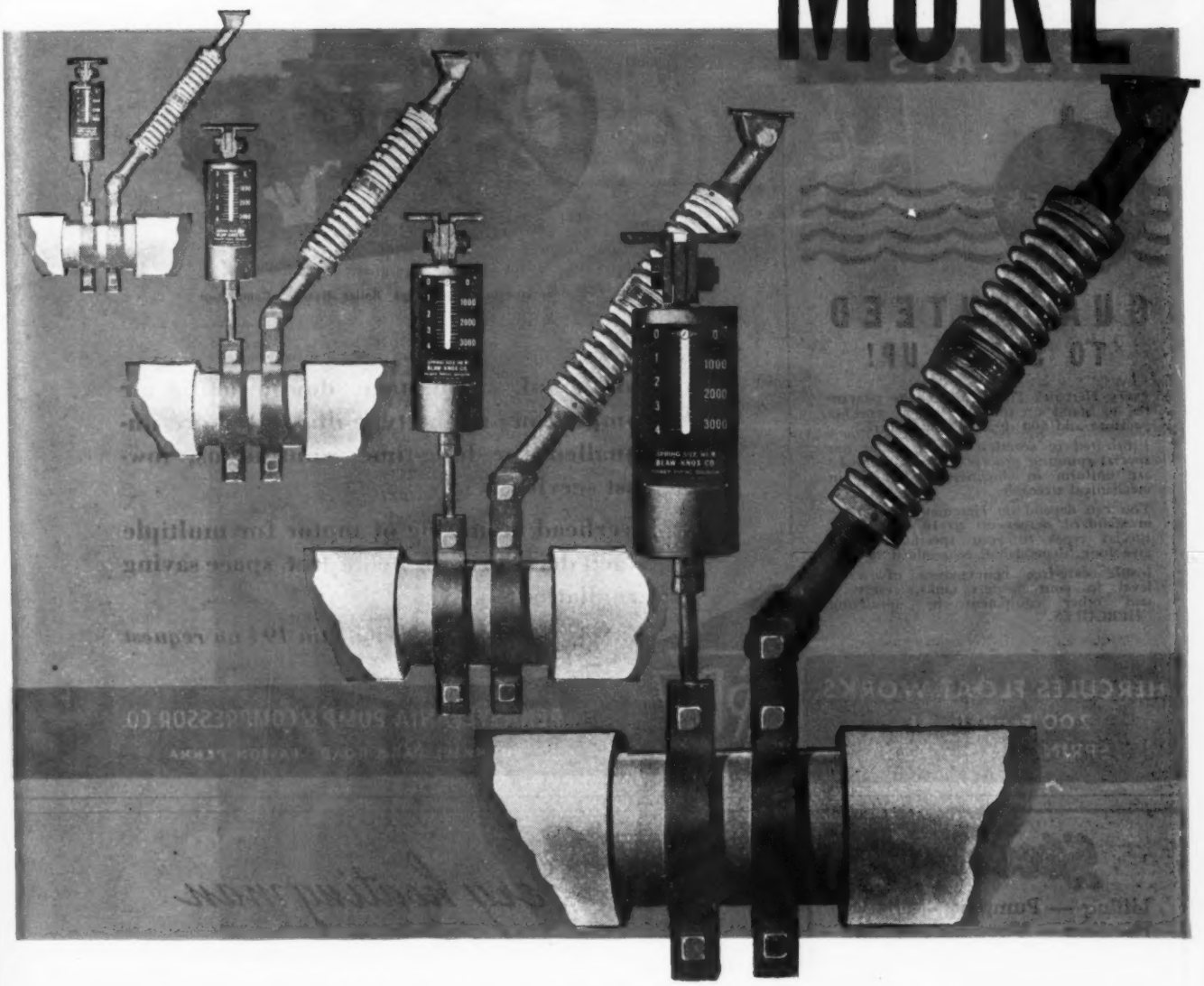

ENGINEERS, POWER SUPERINTENDENTS, AND PLANT MANAGEMENTS SEE BLAW-KNOX PREFABRICATED PIPING, FUNCTIONAL HANGERS, AND VIBRATION ELIMINATORS as the solution to power piping problems.

Send for the NEW Catalog No. 1863 on BLAW-KNOX Power Piping Functional Hangers and Vibration Eliminators.

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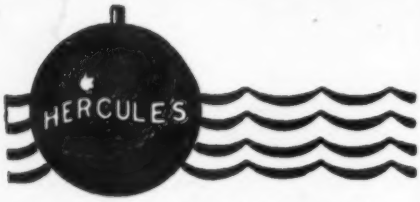
Seamless Copper
FLOATS



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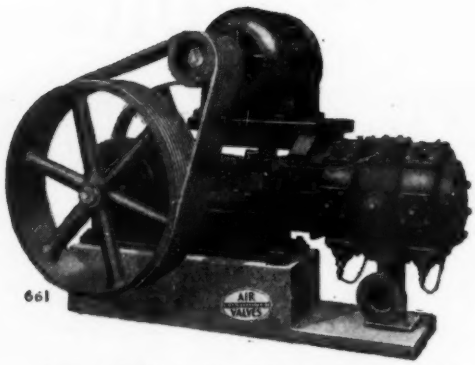

Pennsylvania Single-Stage Roller Bearing Compressor

Horizontal, single-stage, double-acting air compressors of the type illustrated are unequalled for long-time, continuous, low-cost service.

Overhead mounting of motor for multiple V-belt drive provides compact, space saving installation.

Descriptive bulletin 194 on request

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PENNSYLVANIA PUMP & COMPRESSOR CO.
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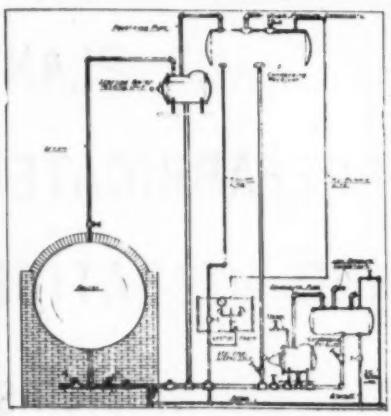
Lifting — Pumping — Boiler Feeding — Vacuum Creating and Vacuum Draining Units



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It retains the condensate temperature, sending it back to the boiler room under pressure without venting to the atmosphere. Only a nominal line drop in temperature giving maximum efficiency, economy and reducing boiler maintenance.

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Every heating man
SHOULD HAVE THIS
NEW CATALOG

This new catalog gives complete working data on Fedders Series 12 Downblow Unit Heaters. They are used for high installations ranging from 15 to 45 feet above the working zone. Other uses include spot locations such as over frequently opened shipping room doors.

Look for Fedders in your classified telephone directory or write the factory for catalog 12 C-1.

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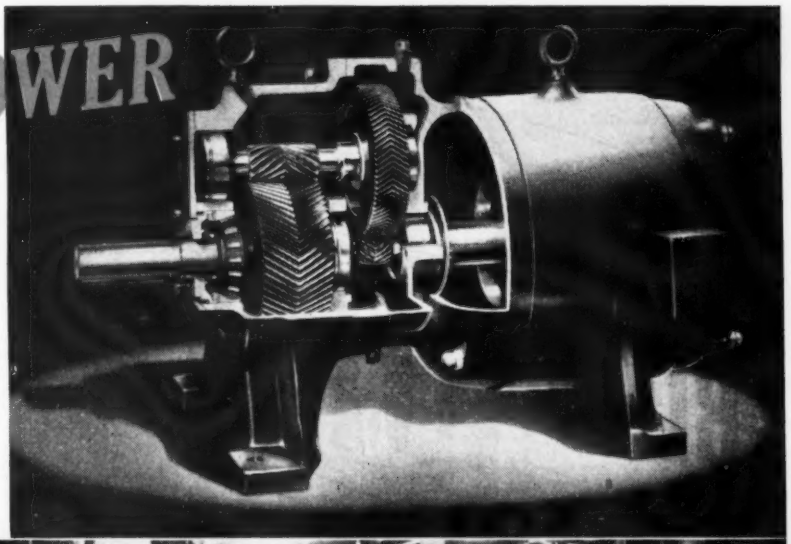
Downblow **UNIT HEATERS**

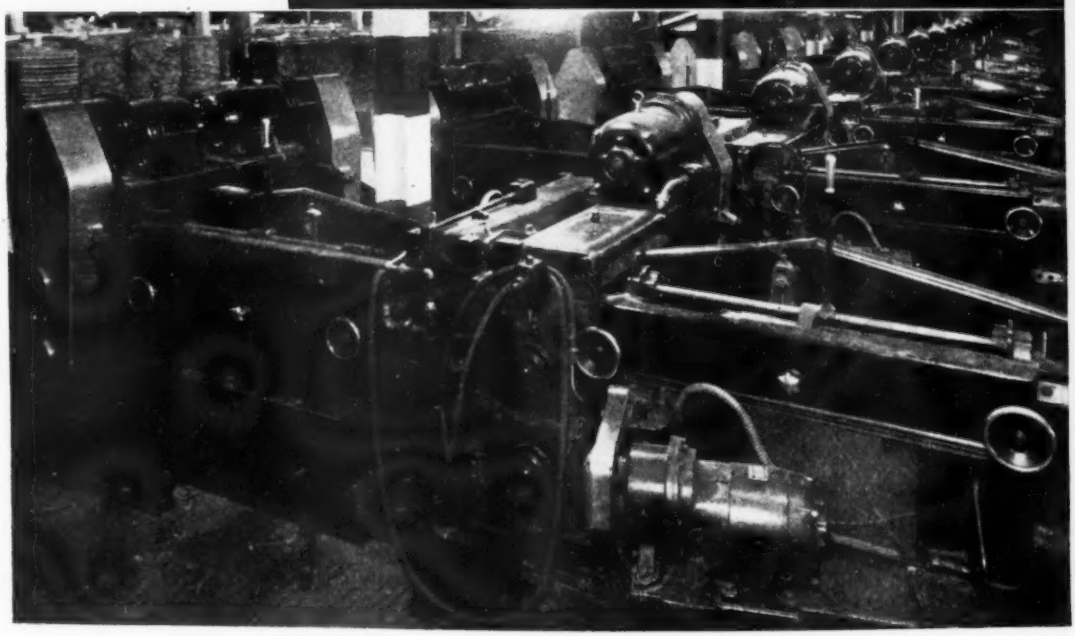
FEDDERS MFG. CO. INC., BUFFALO 7, N. Y.

Keeping the POWER going through



Master Double Parallel Gearhead Motor equipped with Timken Bearings on all Gearhead shafts.

Master Gearhead Motors equipped with Timken Bearings powering tobacco stemming machines.



All final-drive shafts of Master Gearhead Motors are mounted on Timken Tapered Roller Bearings to assure constant delivery of electric power without loss.

Timken Bearings eliminate friction; prevent shaft wear; carry radial, thrust and combined loads with an ample reserve of safety; hold shafts and gears in permanent alignment; and assure accurate gear contact at all times.

These compact, self-contained power units provide an ideal method of applying electric power to all kinds of machinery; and protected by Timken Bearings they operate at the lowest possible cost for operation and maintenance.

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TAPERED ROLLER BEARINGS

The trade-mark "TIMKEN" means more to bearing users today than ever before. Make sure it appears on all the bearings used in your equipment.

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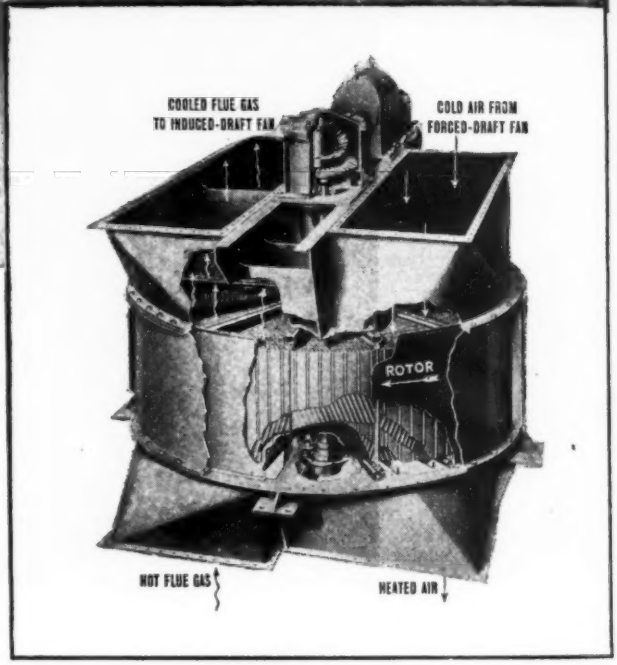
You can BLOW HOT OR BLOW COLD with PREHEAT ENGINEERING



The Ljungstrom Air Preheater is a versatile heat exchange unit. In addition to preheating combustion air to temperatures as high as 1,500 deg. F, it can be applied where cooling is the objective. Cooling involving low-temperature air or gases may be accomplished with units developed by Air Preheater engineers.

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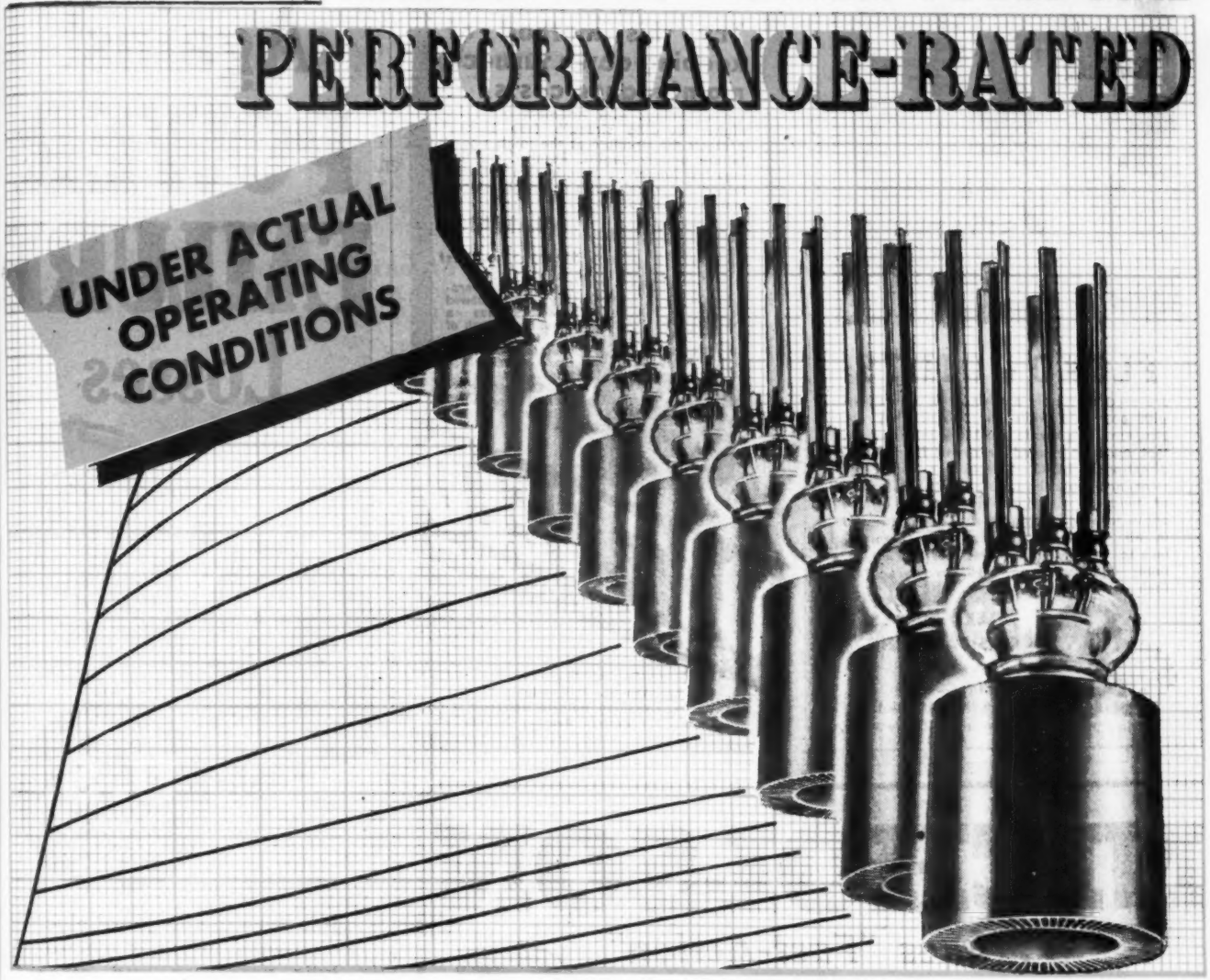
THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

Federal INDUSTRIAL POWER TUBES ARE PERFORMANCE-RATED



Federal Industrial Power Tubes are rated on the basis of actual performance under the same severe operating conditions found in industry . . .

Not from nominal design center values nor from operation under ideal conditions . . . but from actual tests in industrial heating equipment operating with and without work in the load circuit.

Federal tests include conditions where the character of the work changes during the heating cycle and each exacting test is designed to assure long service and economical performance from every tube that bears the name . . . Federal.

Write for information about Federal's "better" industrial power tubes.

TECHNICAL DATA FOR TYPE F-7C25

Maximum Ratings for Maximum Frequency of 50 Mcs.

DC Plate Voltage	3500 volts
DC Plate Current	1.25 amp.
Plate Dissipation	2500 watts
Filament Voltage	11.0 volts
Filament Current	27.5 amps.
Overall Height	app. 7"
Maximum Diameter	3½"

Supplied with 6" flexible copper leads, 2 on each terminal

Type of Cooling	Forced air

(Also supplied for water-cooling, type F-5302)

Federal Telephone and Radio Corporation

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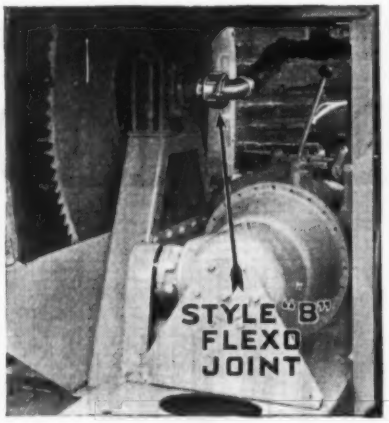

FLEXO JOINTS

are used to supply machinery or equipment with any fluid while in motion. They are also used to provide flexibility in pipe lines that must be moved or swung in different directions. FLEXO JOINTS are safe, efficient and durable and permit a full flow of fluid at all times irrespective of the angle to which swung. Made in 4 styles and in all standard iron pipe sizes from ¼ inch to 3 inches for all pressures to 1350 lbs. superheated steam. Write for details on their use in your service.

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Lay-up linings with Adamant . . . its higher bonding strength (see below) protects the structure at the joints where failure usually begins. Result . . . linings last longer . . . production is maintained . . . repair costs and replacement materials saved.

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Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature: 1270 lbs. at 2600° F. Adamant has a P.C.E. of 3000° F. plus. For more details, write

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It is wise to safeguard electric ovens, furnaces, electrolytic processes and other crucial operations with stand-by service to avoid losses of power failure.
We specialize in the building of this type of Emergency Electric Plant equipment and have successful installations in varied applications throughout the nation.
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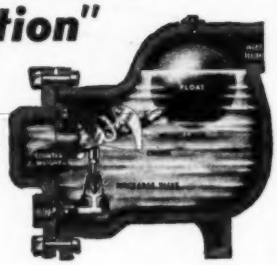
NICHOLSON

Makes "Fast-Action"

TRAPS

FOR

Every Power and Process Purpose



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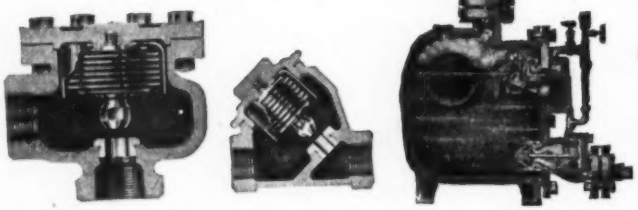

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Featuring exclusive designs, Nicholson performance-proved traps assure enormous discharging capacity and faster, positive action. For all pressures. Descriptive of the complete Nicholson line, our Trap Catalog 444 is a standard reference on drainage problems, whose helpfulness will earn it a permanent place in your files.

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What are your problems?

Cooling salt brine to temperatures — in a range from minus 40° F. to plus 35° F.?

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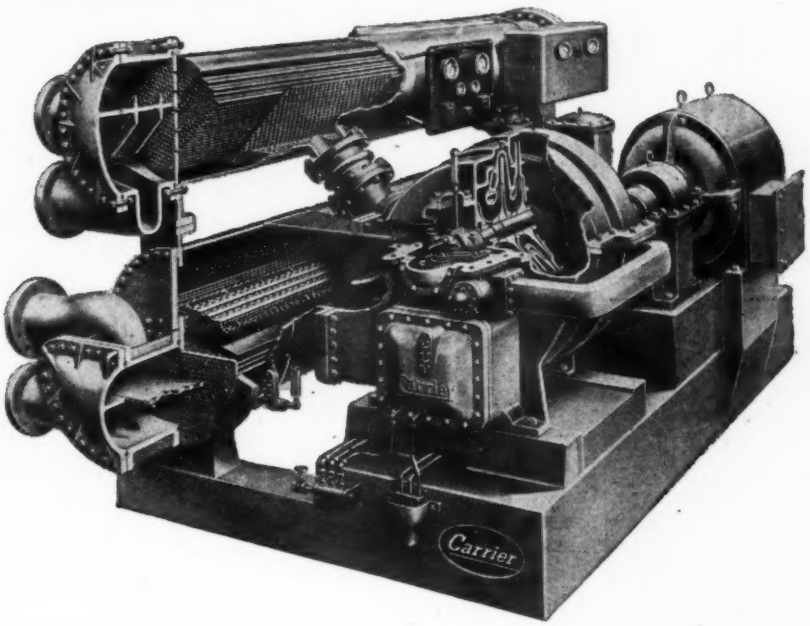
Adapting refrigerating system to your plant heat balance?

Controlling heat of reaction?

Condensing vapors or gases, such as chlorine, hydrocarbons, solvents, ammonia or carbon dioxide?

ANSWER:



THE CARRIER CENTRIFUGAL REFRIGERATING MACHINE has proved the most satisfactory answer to large capacity requirements because of its inherent superiority of engineering and construction. Back of it are more than 20 years of design, manufacturing and operating experience ... The life of the Carrier Centrifugal Compressor is greater than any other type of compressor or rotating machine. There are no wearing parts in the compressor proper — and no erosion or wear at points of clearance ... Compressor efficiency is sustained for the life of the compressor because nothing occurs to change it. So dependable is this Carrier equipment that in many important industrial processes no spare unit is considered necessary. Write today for full information. Carrier Corporation, Syracuse, N. Y.

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IMO pump circulating governor oil and lubricating oil for large turbine.

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For information send for Catalog I-128-P

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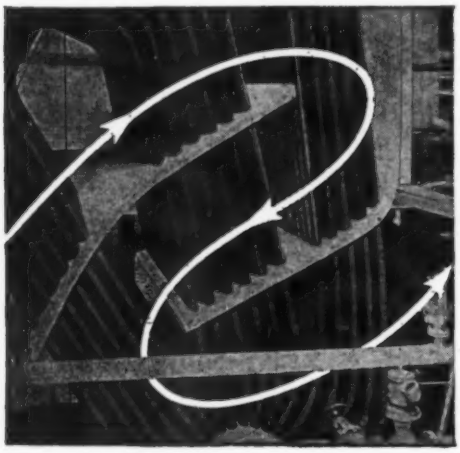

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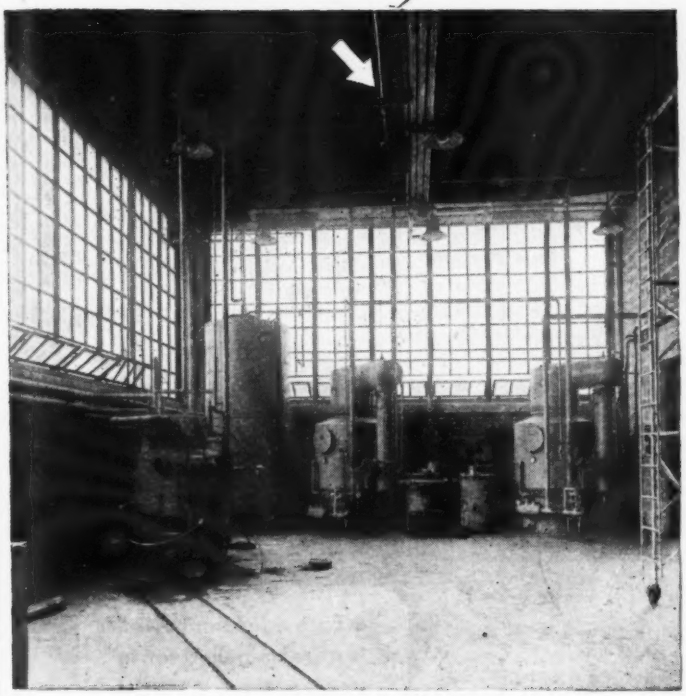
CARDOX Harnesses Carbon Dioxide IN POUNDS OR TONS

For protection of Industry's tough fire hazards



Part of Cardox protected oil reclamation plant

Running fires involving flammable liquids are quickly extinguished by Cardox.

The features that have made Cardox Fire Extinguishing Systems first choice for protecting so wide a variety of tough fire hazards are many. For example, they harness carbon dioxide, in *pounds* or *tons*, and, through engineered control and application, make it equally effective for large or small hazards . . . single or multiple . . . similar or diverse!

Furthermore, Cardox CO_2 is given enhanced extinguishing performance. It has uniform extinguishing characteristics regardless of plant or atmospheric conditions. It provides high CO_2 "snow" yield, thus increasing the cooling effect upon fire zone and combustibles. In addition, it provides effective projection through relatively great distance . . . even outdoors through strong winds.

If you have tough or unusual fire hazards draw on the Cardox Research Division and Engineering Staff for practical cooperation in determining the most effective protection. Ask for Bulletin 995.

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CO_2 FIRE EXTINGUISHING SYSTEMS

Cardox CO_2 is supplied instantly in pounds or tons from a single storage unit containing 500 pounds to 125 tons at controlled low temperature of 0°F and 300 p.s.i.

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Stops Leaks and Prevents Scoring

This universal packing—consisting of long, tough asbestos fibres, thin flakes of anti-friction metal, minute graphite scales and a heat-proof lubricant—is recommended for general service against steam, water, air, ammonia, oils, gases, etc., where temperatures do not exceed 600 F. Fits all sizes and shapes of stuffing boxes. Special styles available for high temperature and corrosive liquids, food products, etc. Try it and you'll use it regularly.

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Make Your Overhead Valves SAFE And Easy to Reach---

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

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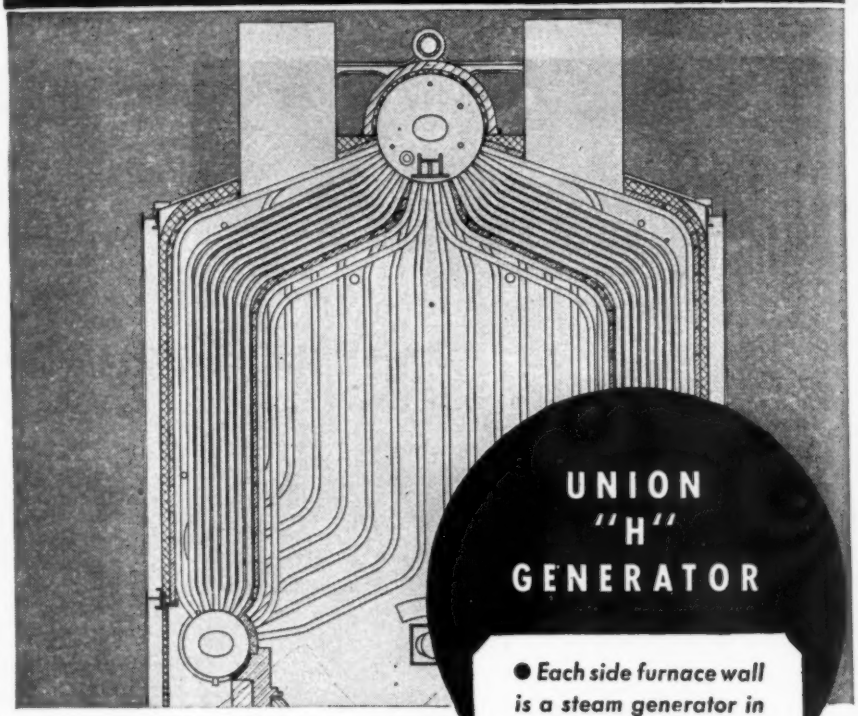
UNION



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- *Each side furnace wall is a steam generator in itself, yet an integral part of the boiler unit.*
- *Front and rear refractory walls are protected by a water wall with no complicated headers or circulating tubes.*
- *Lower drums are out of the fire.*
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Better Threads

FOR THE PIPES OF PEACE!

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Backed by nearly half-a-century's experience... Toledo-Engineered for accurate, easy operation and long-life dependability. Specify TOLEDO to keep your costs down and production UP!

No. 999 2" POWER PIPE MACHINE. Save time, cut costs and do a better job—with this small, compact, portable Toledo Power Pipe Machine. For cutting, threading and reaming up to 2" capacity. It threads 2" pipe in 22 seconds, cuts off 2" pipe in 10 seconds. Smaller sizes relatively fast. Widely used and preferred in shipyards and large war plants. Ideal for production-line speed in new building! The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.

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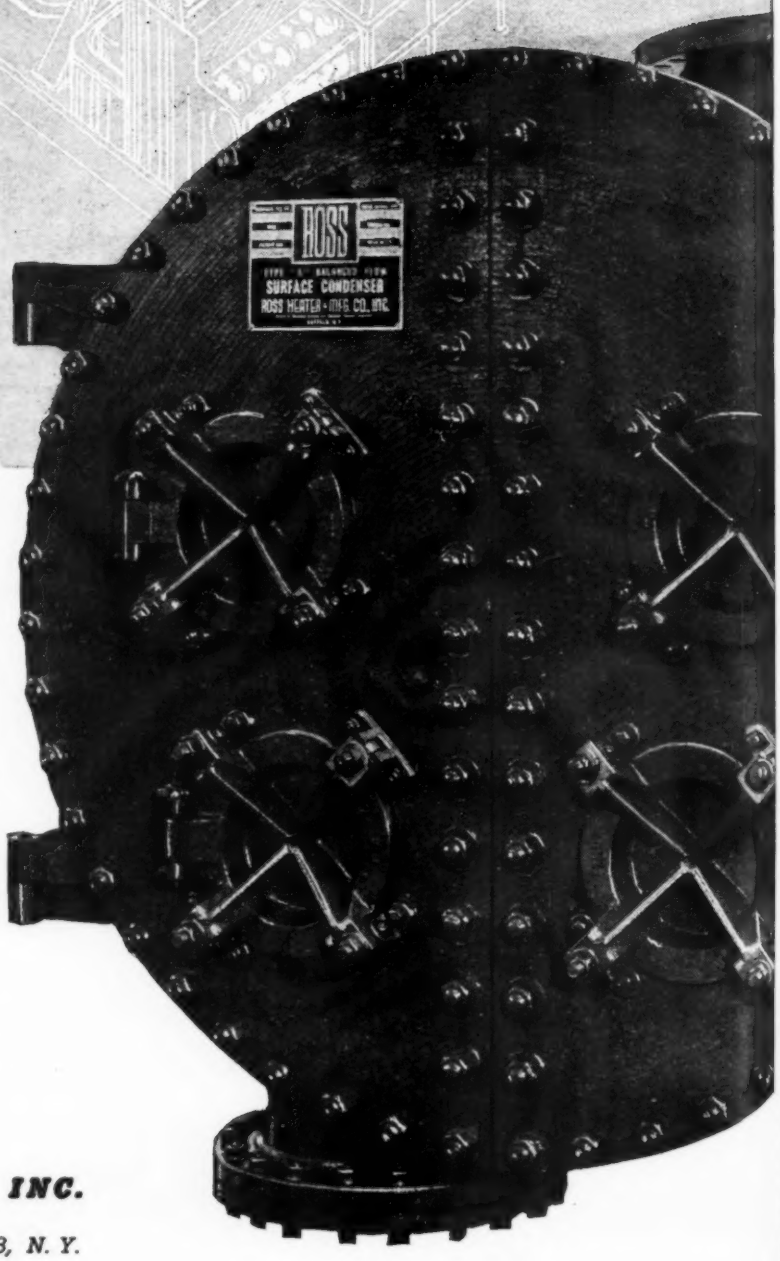
FOR PRECISION PIPE TOOLS

SERVICING SPEED IS VITAL!

Turbine-Generators Deliver Power Only While CONDENSERS Are Operating



Power plant engineers find in Ross Surface Condensers the perfect combination of sound engineering principles and well planned structural details. *Both make for minimum service interruptions.*

Production of high vacuum is continuous . . . but, if local conditions should require temporary shutdowns, accessibility for inspection or cleaning is simple and quick through *special structural details.*

Full information covered in MANUAL 4017 . . . a valuable book for every power plant engineer.

ROSS HEATER & MFG. CO., INC.

Division of American Radiator & Standard Sanitary Corporation

1415 WEST AVENUE BUFFALO 13, N. Y.

Baffles check erosion of heater tubes

TUBES were failing in a horizontal chemical heater after three years of service, yet similar tubes in a vertical heater showed no corrosion after 13 years. Steam enters the top of the shell at one end under 38 lbs. pressure and is removed as condensate at the bottom near the opposite end. Caustic flows through the tubes. Failures were occurring in the first 18 inches from the tube sheet where caustic enters and maximum condensation of steam occurs.

Sections of the tubes were submitted to Scovill and subjected to examination. Little scale or corrosion was found, on either surface, but the outside surfaces showed uniform thinning along their lengths. Wall thickness was reduced approximately .005″ to .01″.

MISSING FILM LEADS TO CAUSE

Scovill traced this thinning of the walls to erosion, caused by impinging steam and condensate. This erosion was of sufficient magnitude to destroy the protective films, exposing clean metal surfaces to progressive corrosion by condensate and gases. Scovill suggested an alternative in the arrangement of baffles to minimize erosive action on the tube surfaces. This change was made and tube life was improved. The tube material has excellent resistance to corrosion by caustic and also to corrosion by steam and condensate, so no change in tube alloy was required.

OTHER SCOVILL SERVICES

In addition to *Service in Men* — consisting of consultation on tube problems and installation methods, Scovill offers two other services. *Service in Metals* covers the selection of alloys and study of specific problems in field and laboratory. *Service in Manuals* offers literature on condenser and heat exchanger tubes. For a copy of the booklet *Scovill Condenser Tubes*, address Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Connecticut.

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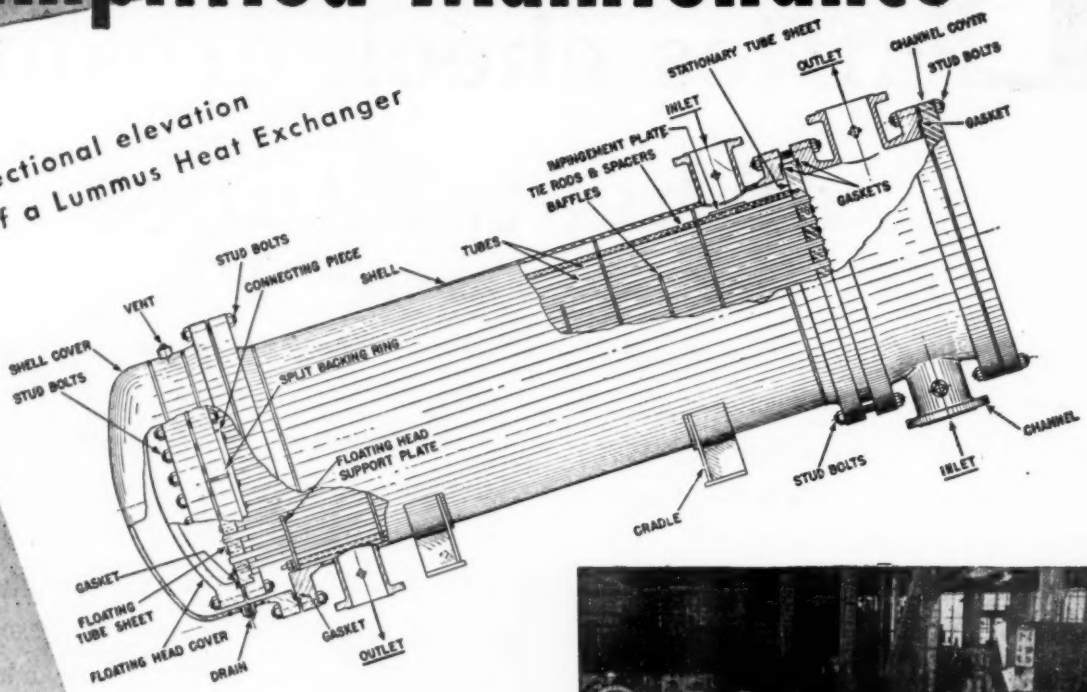
MANUFACTURING COMPANY
WATERBURY 91, CONN.
CONDENSER TUBES
ONE PRODUCT . . . THREE SERVICES
Service in Manuals . . . Service in Metals . . . Service in Men

Simplified Maintenance

Sectional elevation of a Lummus Heat Exchanger



1 BASIC DESIGN
6 STANDARDIZED SIZES
for 102 OPERATING UNITS

Simplified maintenance is of major importance in isolated overseas oil refinery operation. Here again, Lummus experience — in designing and fabricating heat exchangers — solves a war-time emergency with soundly based, simplified design. Tube bundles, gaskets, etc., are held to one basic design in six standardized sizes. A maximum degree of interchangeability is permitted with an absolute minimum number of spare parts.

In all, a carefully calculated engineering feat in simplification — for a complete oil refinery installation requiring one hundred and two heat exchanger operating units.

Lummus engineering service is always available for the study of specific heat exchanger problems. For further information write to: The Lummus Company, 420 Lexington Avenue, New York 17, N. Y.

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LUMMUS EQUIPMENT

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STRAIGHT-WAY

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You Get

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POSITIVE CONTROL

LOWER UPKEEP

LONGER SERVICE

with HOMESTEAD Quarter-Turn Valves

INSTANT ACTION because a Quarter-Turn *fully opens* or *closes* these valves. They operate 16 to 28 times *faster* than screw-stem types.

POSITIVE FLUID CONTROL because cam presses seating surfaces firmly together in closed position, yet valve operates freely. Sealed bottom, bonnet and stem, prevent wasteful, outside leakage.

LOWER UPKEEP AND LONGER SERVICE because seating surfaces are protected in the closed position and turned completely out of the fluid path in the open position. Thus shielded from corrosion or erosion by fluids, longer life is assured.

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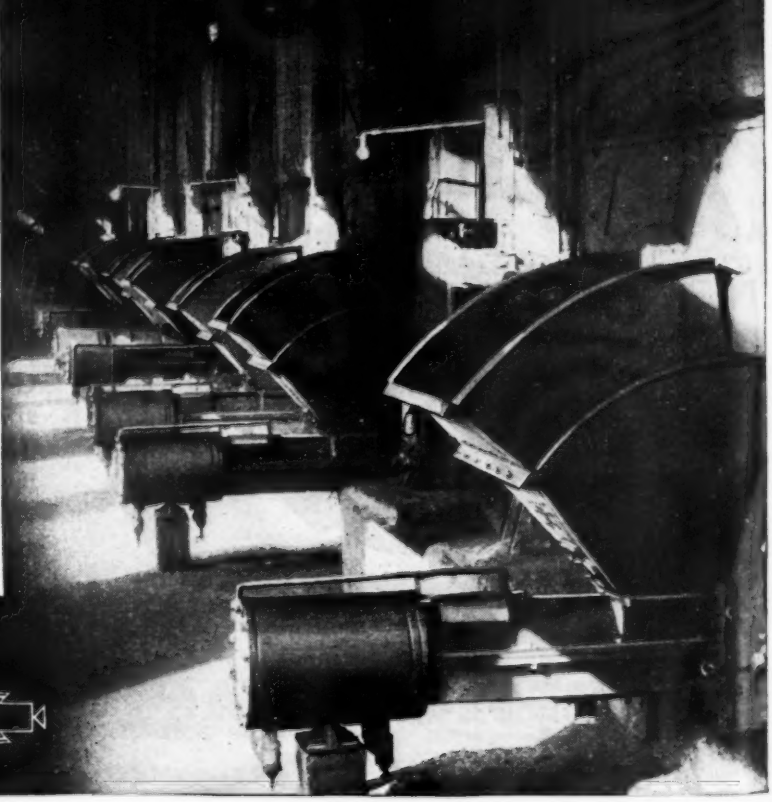
CRYSTOLON BRICK *for Boiler Furnaces*

DO AWAY WITH "WATCH AND PRAY" METHODS

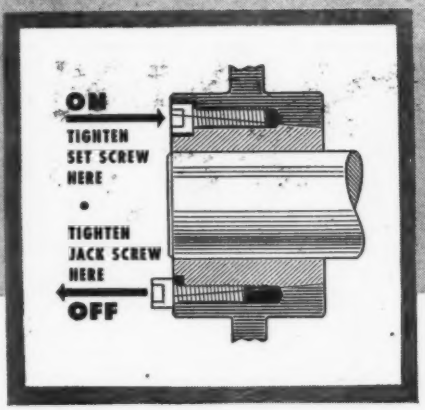
CRYSTOLON (silicon carbide) Brick banish "watch and pray" methods when it comes to refractory linings for boiler furnaces. It pays to install these highly refractory brick which guarantee long, trouble-free service because they are physically rugged, chemically inert and resistant to abrasion. Coal ash slag cannot penetrate the hard, dense surface of CRYSTOLON Brick and this makes clinker removal a short, easy operation.

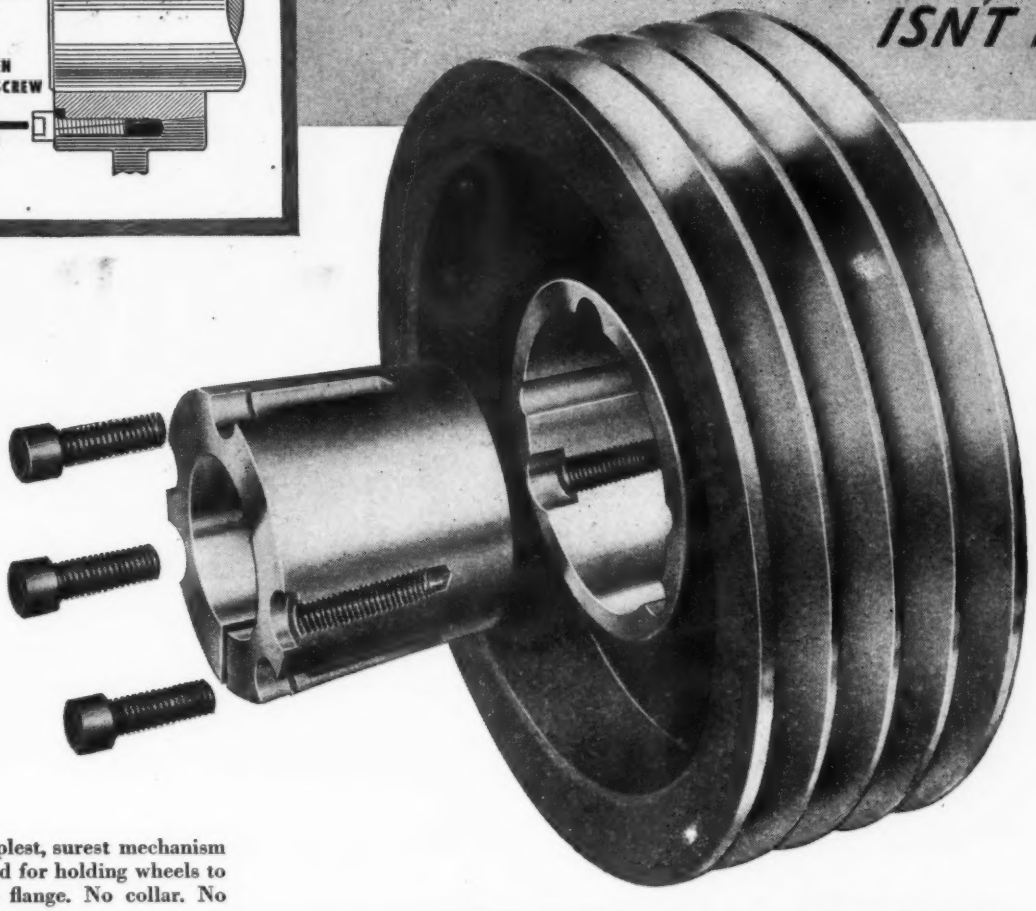
NORTON COMPANY
Worcester 6, Massachusetts



NORTON REFRACTORIES

Simple, ISN'T IT?





- The simplest, surest mechanism ever devised for holding wheels to shafts! No flange. No collar. No protruding parts.
- The Taperlock Sheave mounts as a complete unit. Slip it on, line it up and tighten *while sighting*. It's in place on the first try!
- The bushing is wedged into the sheave by means of set screws—with a firmness equivalent to a shrunk-on fit—whether the shaft is standard or normally undersize.
- The Taperlock runs *true*. The bushing extends the entire length of the hub; it provides a *full* bearing surface.
- Close mountings are made possible. No flange nor collar nor other device is required at either end of the sheave hub.
- The Taperlock "unlocks" with less effort than any other sheave—due to its special taper.
- Taperlock Sheaves will be stocked by Dodge Transmissioneers in principal cities—and will be available in ALL stock sizes.

New TAPER-LOCK *Sheave*

PATENT APPLIED FOR

Easy on—easy off—locks fast to the shaft! ALL the advantages you've ever dreamed about in a sheave are *here*—in the simplest, quickest acting mechanism ever developed for the purpose!

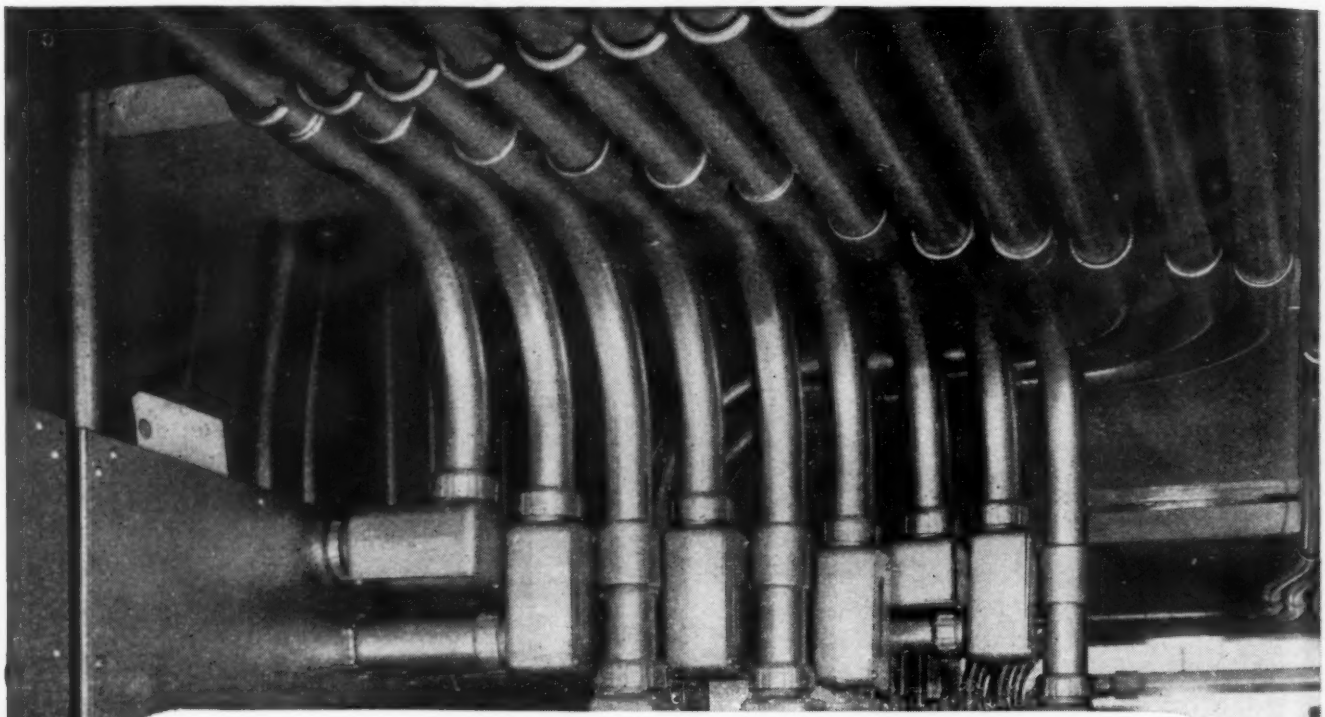
For full details call your local Dodge Transmissioneer. You'll find his name listed under "Power Transmission Equipment" in your classified telephone directory. Or write

DODGE MANUFACTURING CORPORATION, MISHAWAKA, INDIANA

DODGE
MISHAWAKA

SIGN OF THE DODGE TRANSMISSIONEER
There are 257 Dodge factory graduate Transmissioneers, located in principal cities, to show you NEW and BETTER ways of transmitting power. See your local classified telephone directory.

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*



Smart Post-War Planning Demands SAFE Wiring Methods

A double responsibility confronts the electrical industry:

1. The obligation to replace makeshift, unsafe wiring systems, installed according to "must do" emergency ideas, forced on industry by war time shortages and regulations.
2. The duty to install only assuredly safe wiring systems in all new post V-Day construction.

Remember this: The only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations is a standard-threaded rigid conduit.

With standard-threaded rigid steel conduit, such as Youngstown's Buckeye, again available through distributors, there is no reason not to provide dependable wiring protection.

Wherever there is moisture, or vapor, or excessive vibration, or possibility of corrosion, or accumulating dust and dirt, or danger of crushing or other mechanical injury, specify and use Youngstown Buckeye Conduit.

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit - Pipe and Tubular Products - Sheets - Plates - Electrolytic Tin Plate - Coke Tin Plate - Bars - Rods - Wire - Nails - Tie Plates and Spikes.

Your Condensers Last Longer When APEXIOR NUMBER 3 Keeps the Metal Dry

In condensers and cooling equipment accelerated corrosion is prevented, when metal is coated with APEXIOR NUMBER 3.

Whether the water is salt or fresh, as long as its temperature remains under 125°F., APEXIOR NUMBER 3 protects the metal it covers . . . with a film a few thousandths of an inch thick. Many years of successful application to the water-side of cold water tanks, stern plates of marine vessels, potable water tanks, condensers and water-cooling equipment prove its ability to give metal surfaces longer life.

What is APEXIOR NUMBER 3?

APEXIOR NUMBER 3 is a shiny-black technical protective coating made of 100% asphalts dissolved in a suitable completely-volatile solvent. When dry it is non-toxic, stable and wear-resistant.

To prepare for APEXIOR NUMBER 3, clean surfaces thoroughly to bare metal — sandblast if possible — then apply two coats of APEXIOR NUMBER 3 like a paint, using a hand brush. An original abrasive blast cleaning (never again necessary) prepares for a permanent maintenance base upon which APEXIOR protection can be established. For internal surfaces of tubes, special brush equipment is available for use with standard air turbines. APEXIOR NUMBER 3 is shipped ready-for-use — no thinner permitted.

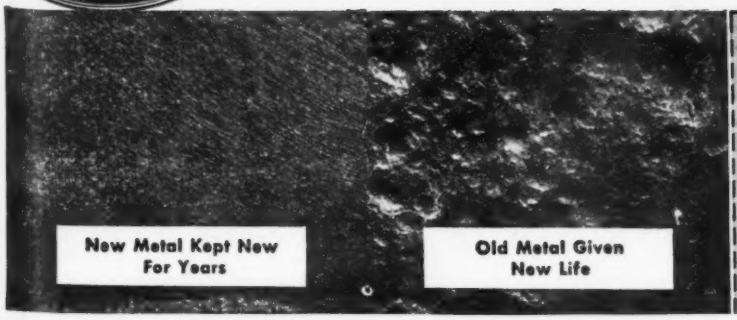
Here's economical insurance against the destructive effects of water-contact for any metallic cold-water handling equipment.

Get additional details today. Use the coupon below or your own letterhead. The Dampney Co. of America, Waterman Bldg., Hyde Park, Boston 36, Mass.

APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY



THE DAMPNEY COMPANY OF AMERICA
Waterman Bldg., Hyde Park, Boston 36, Mass.

Please send free Bulletin 1290.

Name .....

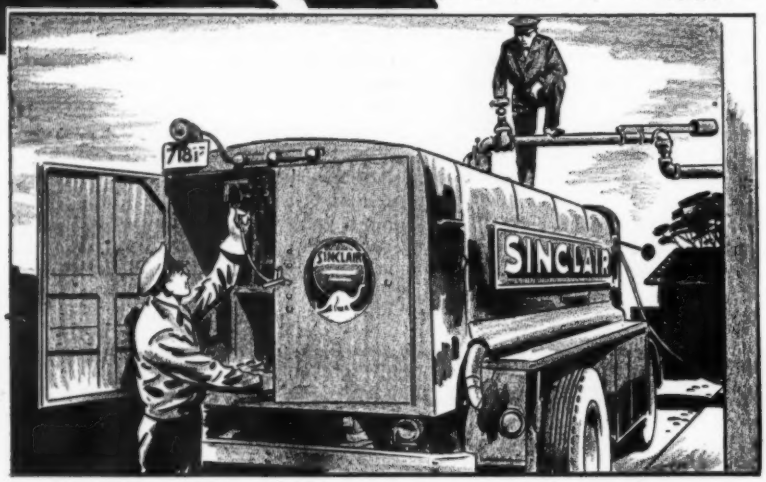
Company .....

Address .....

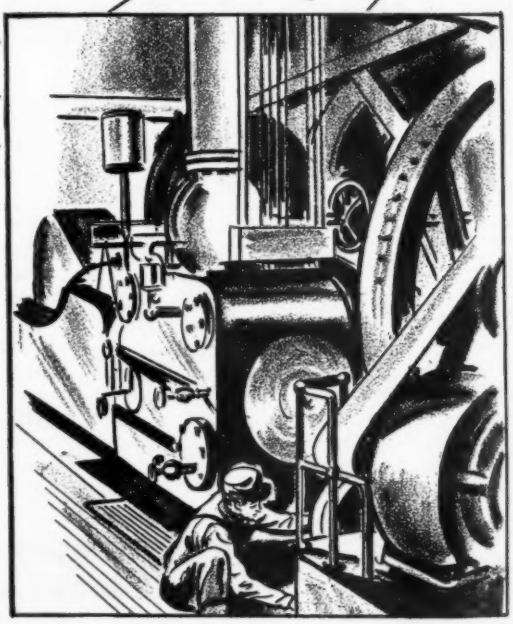
.....

Do you know that . . .

LAST YEAR MORE AIRLINE PASSENGERS IN THE UNITED STATES FLEW ON SINCLAIR PENNSYLVANIA MOTOR OIL THAN ON ANY OTHER OIL . . . SINCLAIR AVIATION GASOLINE WILL AID FLYING ON NATIONAL AND INTERNATIONAL ROUTES.



SINCLAIR TANK TRUCKS OPERATE OUT OF 2000 WHOLESALE BULK PLANTS WHICH SERVICE INDUSTRIAL PLANTS, AS WELL AS MANY THOUSANDS OF SINCLAIR DEALER STATIONS, WITH PETROLEUM PRODUCTS.



FOR REDUCED WEAR AND SATISFACTORY LUBRICATION UNDER ALL LOAD CONDITIONS SINCLAIR PROVIDES STEAM CYLINDER AND VALVE OILS SUITED TO EVERY COMBINATION OF ENGINE REQUIREMENTS.

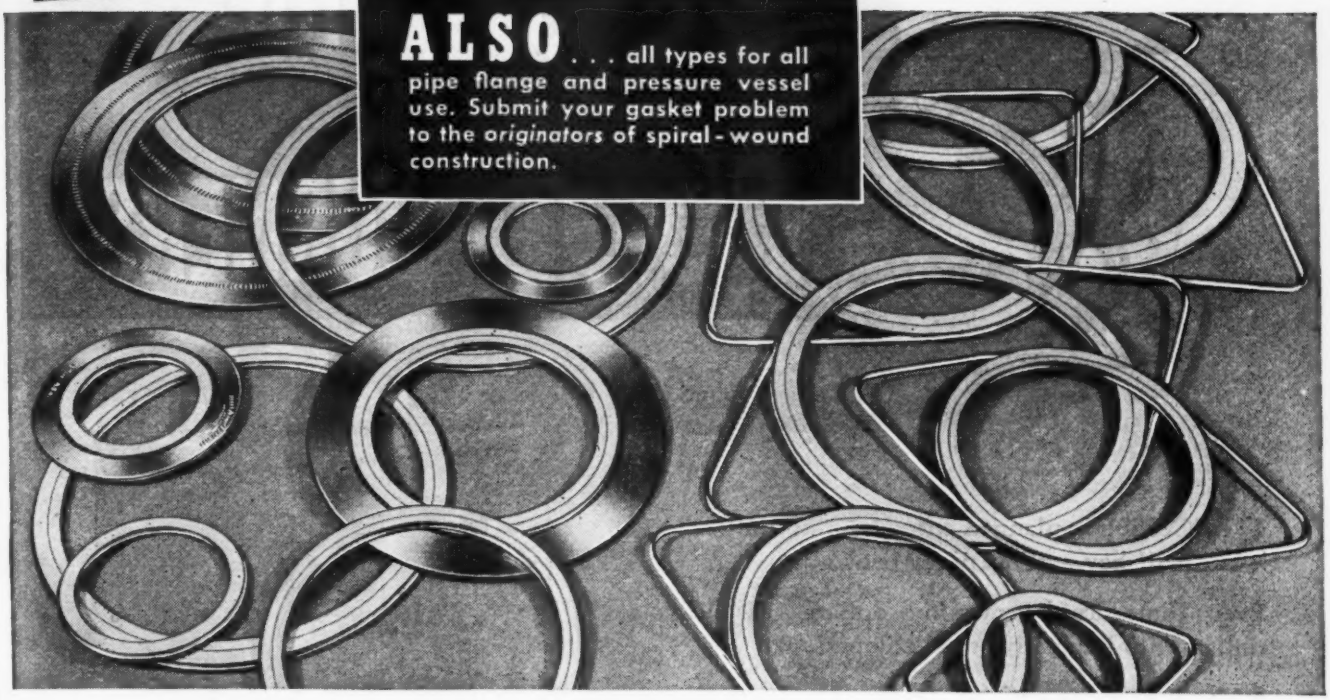
SINCLAIR IS EQUIPPED TO SERVE YOU BETTER!

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

C-G —Retaining ring (Compression Gauge) type. Assures proper bonding values.

D —Popular centering guide type incorporates patented Flexitallic construction features.

ALSO . . . all types for all pipe flange and pressure vessel use. Submit your gasket problem to the *originators* of spiral-wound construction.



DESIGNED FOR ANY TEMPERATURE...

ANY WORKING PRESSURE

- ✓ No Leakage
- ✓ No Bolt Stress Problems
- ✓ No Vibration Worries
- ✓ No Chemical Problems

Given the simple necessities of adequate seating surface and bolting, there is no gasket problem that Flexitallic Spiral-Wound Gaskets can't beat!

Flexitallic is the *original* spiral-wound gasket. Basically its unique metal and asbestos construction is the soundest, most logical approach to difficult sealing problems. Beyond this, however, Flexitallic offers the results of over a third of a century of research and engineering devoted *exclusively* to the continuous development of new and improved spiral-wound types, alloys and designs for exacting modern applications.

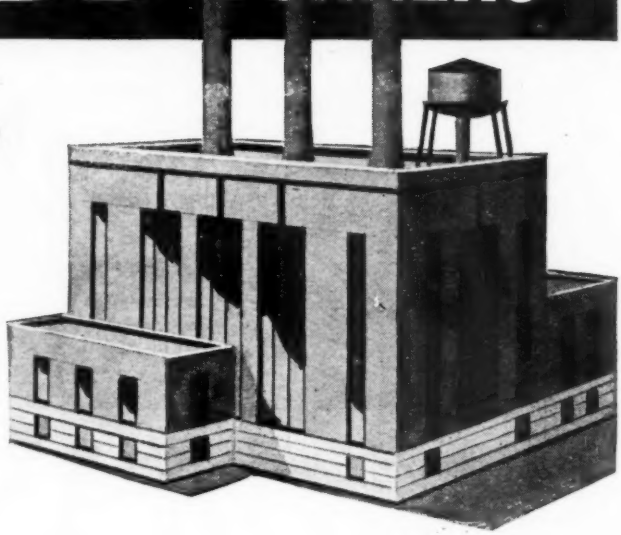
FLEXITALLIC GASKET COMPANY
81st & BAILEY STS., CAMDEN, N. J.

"Flexitallic" GASKETS

REG. U. S. PAT. OFFICE

SAFE, SURE SEALING FOR ALL FLANGED JOINTS

PLANNED ECONOMY begins with TODD BURNERS



SUCCESSFUL, planned economy is not unlike a small boy and his piggy bank.

Every dime saved grows into dollars . . . and dollars into impressive total amounts.

Such savings are entirely possible through the installation of the *right* Todd Burners, which can save you 10¢ out of every dollar spent for oil or gas, in production of power and heat.

At the same time Todd Oil and Gas Burners give you efficient automatic control, adjustable to your power needs, and appreciably increase your power output.

Result: *Reduced cost per pound of steam* leading to lessened operating costs and total plant overhead.

Todd for thirty years has supplied the world with efficiency-tested liquid and gaseous combustion equipment; today there is available to you a *complete* line of *completely* modern Todd Burners, rightly adapted for all power and heat uses in the industrial, commercial and marine fields.

Summon a Todd trained engineer. He'll be glad to go over your specifications with you and explain how modernization with Todd will save you money.

ARMY E NAVY

COMBUSTION EQUIPMENT DIVISION

TODD SHIPYARDS CORPORATION

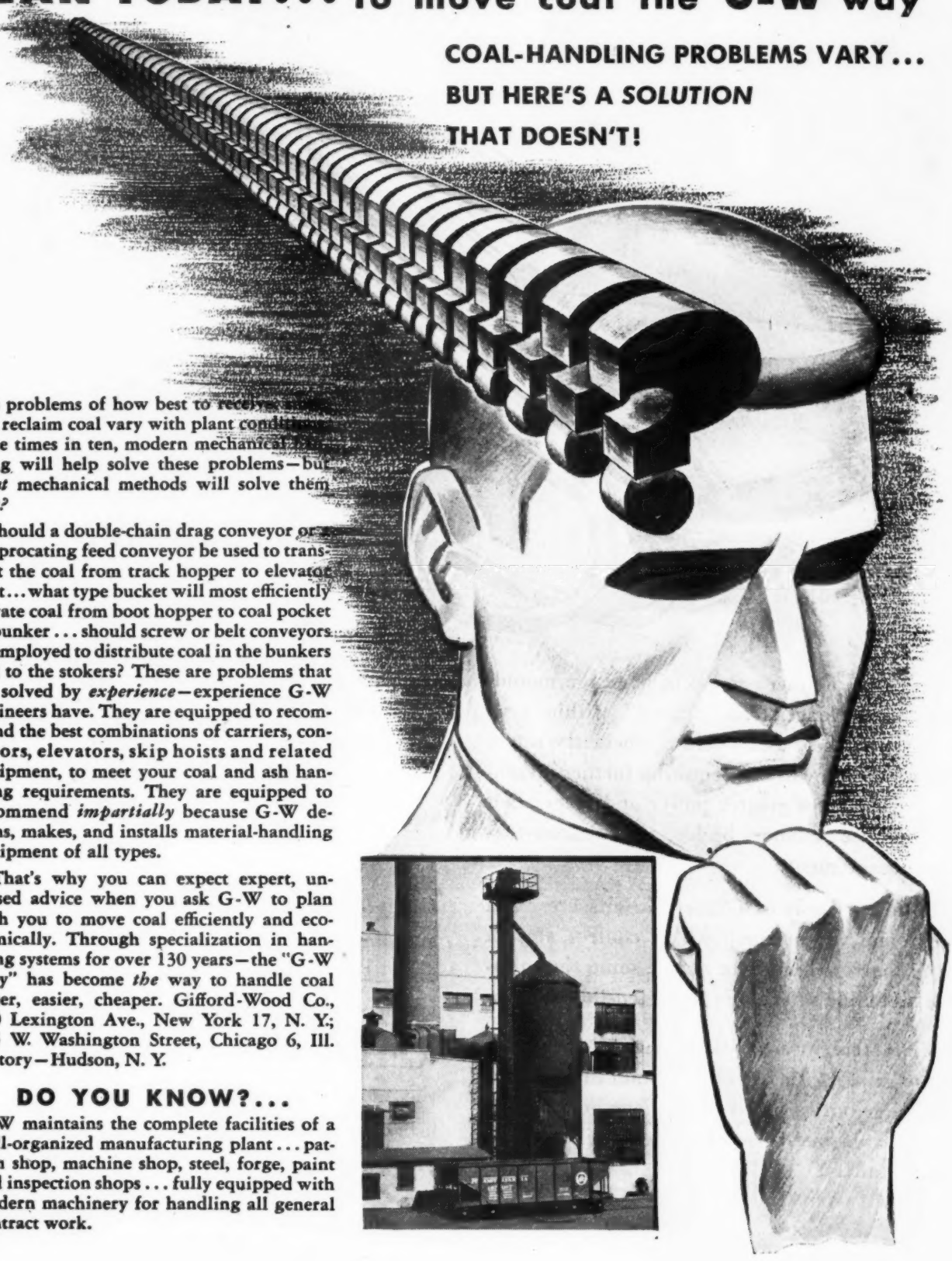
601 West 26th Street, New York 1, N. Y.

NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, PHILADELPHIA, SO. PORTLAND, ME., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, CHICAGO, GRAND RAPIDS, TAMPA, GALVESTON, HOUSTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, TACOMA, MONTREAL, TORONTO, BUENOS AIRES, LONDON

ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

PLAN TODAY... to move coal the G-W way

COAL-HANDLING PROBLEMS VARY... BUT HERE'S A *SOLUTION* THAT DOESN'T!



The problems of how best to receive, store and reclaim coal vary with plant conditions. Nine times in ten, modern mechanical handling will help solve these problems—but *what* mechanical methods will solve them *best?*

Should a double-chain drag conveyor or a reciprocating feed conveyor be used to transport the coal from track hopper to elevator boot... what type bucket will most efficiently elevate coal from boot hopper to coal pocket or bunker... should screw or belt conveyors be employed to distribute coal in the bunkers and to the stokers? These are problems that are solved by *experience*—experience G-W engineers have. They are equipped to recommend the best combinations of carriers, conveyors, elevators, skip hoists and related equipment, to meet your coal and ash handling requirements. They are equipped to recommend *impartially* because G-W designs, makes, and installs material-handling equipment of all types.

That's why you can expect expert, unbiased advice when you ask G-W to plan with you to move coal efficiently and economically. Through specialization in handling systems for over 130 years—the "G-W Way" has become *the* way to handle coal faster, easier, cheaper. Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington Street, Chicago 6, Ill. Factory—Hudson, N. Y.

DO YOU KNOW?...

G-W maintains the complete facilities of a well-organized manufacturing plant... pattern shop, machine shop, steel, forge, paint and inspection shops... fully equipped with modern machinery for handling all general contract work.

GIFFORD-WOOD

G-W HANDLES IT
Faster · Easier · Cheaper

SINCE 1814

379

PRECISION MOULDED BY A SPECIAL GILMER PROCESS

GILMER ENDLESS V-BELTS FOR MULTIPLE DRIVES

In the Gilmer process of precision moulding, V-Belt lengths are "cured" within very small tolerances, and operate efficiently under correct tension without requiring further matching. This assures greater power and longer belt life because Gilmer builds to full-load-tension measurement.

The pulling cords of Gilmer V-Belts are extra tough and are normalized to control stretch within narrow limits yet at the same time provide an ample safety margin of tensile strength.

Special straight-side construction assures a tighter grip. As the belts flex around the sheaves, they bulge outward, exerting a firm hold. When pressure is released they unlock freely and instantly.

Gilmer Endless V-Belts are manufactured in all standard and many special sizes, for multiple and FHP drives, heavy or light duty, high or low speeds, long or short center drives.

Write for a FREE copy of the Gilmer Guide, the most complete V-Belt catalog ever published. It contains much valuable data that every power plant engineer should have.

L. H. GILMER COMPANY

Tacony, Philadelphia 35, Pa.
Division of United States Rubber Company

Gilmer BELTS

There are Gilmer Belts for all power transmission needs

RELIANCE *Series C* MOTORS

WITH DOUBLE-SHIELDED BALL BEARINGS

GIVE LONGER, TROUBLE-FREE SERVICE!

DOUBLE SHIELDED BALL BEARING
SHIELDS PROTECT BEARING AGAINST OVER-LUBRICATION KEEP GREASE IN, DIRT OUT
GREASE SEAL AGAINST MOISTURE AND DIRT
NO LEAKAGE OF GREASE INSIDE OF MOTOR
CLEARANCE FOR ELIMINATION OF EXCESS GREASE
CROSS-SECTION OF DOUBLE-SHIELDED BEARING IN HOUSING

A BALANCED DESIGN, PRECISION BUILT

1. **Protecting enclosures** keep out dirt, chips, oil, excess moisture.
2. **Steel stators for strength,** incorporating experience from building motors to meet Navy high shock requirements.
3. **Thirteen-step winding treatment,** for maximum stator protection.
4. **Pressure cast rotors** provide trouble-free aluminum windings.
5. **Heavy shafts,** liberally designed for added strength.
6. **Improved bearing lubrication** affords *real* protection to bearings and windings.
7. **Optional lead outlet arrangement** permits machine mounting with elimination of conduit box.
8. **Flange and face type brackets** offer alternative methods of machine application.

Send for Instruction Sheet 3042, which tells about Reliance double-shielded bearing design and why it needs no special attention. Information worth having, and it's yours for the asking.

HERE'S good news for users of electric motors! No special lubrication attention is necessary with Reliance Series C Motors.

Just follow whatever greasing practice you have established for ball bearing motors. Properly lubricated, over-greased or under-greased, the Reliance design provides the answer to securing longer bearing life.

If under-lubricated after installation, bearings with this design will last longer than non-shielded bearings given the same treatment. This is because of grease retained within the shields plus grease remaining in the housing from its initial filling.

If over-greased after installation, they will operate satisfactorily without overheating, whereas non-shielded bearings under the same treatment may fail.

It is not necessary to disassemble motors at the end of fixed periods to grease bearings. Bearing shields do not require renewal.

Simplified lubrication procedure and longer life are good reasons for preferring Reliance A-c. and D-c. Motors. Some of the other reasons are indicated at the left. Write to or call the nearest Reliance office for complete information.

RELIANCE ELECTRIC & ENGINEERING CO.

1068 Ivanhoe Road **Cleveland 10, Ohio**

Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville • Houston • Kalamazoo
Knoxville • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Pittsburgh
Portland, Ore. • Rockford, Ill. • St. Louis • San Francisco • Seattle • Syracuse • Washington, D.C.

RELIANCE (A-C) (D-C) MOTORS

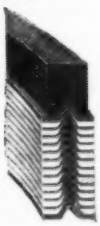
SEE OUR CATALOG IN SWEET'S

EASY POSITIVE LEAKPROOF installation with AJAX "SR" FLANGE GASKETS

The AJAX "SR" Flange Gasket is equipped with a solid steel outer ring that acts as a centering device for positive centering inside the bolt circle of the flanges—provides reinforcement that prevents blowout of gaskets under severe conditions—and acts as a compression gauge to eliminate using feeler gauges during installation. Your pipe fitter merely pulls the flanges down to the ring and a gasket barrier is set up to withstand conditions as specified for the flange series.

Installed with its reinforcing ring, the "SR" gasket is your guarantee against leaks and blowouts under pressures up to 2500 pounds.

"SR" series are available for standard or non-standard fittings. Your service requirements and specifications determine the number of metal and asbestos spiral turns per diameter in each gasket. The gasket is readily removable from the reinforcing ring for replacement.



★ **"THE STORY BEHIND THE GASKET THAT BREATHES"**

Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions — and retains the positive, secure seal you require at all times.

The above cutaway is the AJAX SR Compression Gauge Flange Gasket

Write today for complete AJAX data—available in Catalog 202

U. S. GASKET CO.

1592 PIERCE AVENUE, CAMDEN, NEW JERSEY

Distributors
IN PRINCIPAL CITIES
A few choice industrial territories are open

It's greatest critics...

..ARE THE MEN WHO MADE IT!

● From its very beginning, the molding . . . the metal . . . its pouring and finishing—men long experienced in all phases of foundry work carefully nurse, guard and watch over every Sivyer casting.

These men insist upon castings as perfect as it is possible to make them. For only by having them this way will they uphold the high standards of Sivyer steel castings . . . entitle them to carry the Sivyer diamond ◈ —the mark worth looking for.

The next time you order steel castings, try Sivyer.

ARMY E NAVY

SIVYER STEEL CASTING COMPANY

MILWAUKEE S CHICAGO S

American industry flows through fairbanks valves

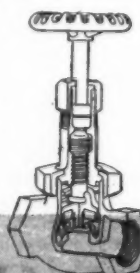
BUILDING—
tomorrow's wakening giant

After war's final "cease-firing", look for the building industry to go places . . . for vast cities-within-cities to take shape. They're on drafting boards today.

Air conditioning and ventilating will be widened to include removal of dust, bacteria and odors from the atmosphere by unit-type air sanitation equipment. On the upswing will be radiant heating, zoned heating, service hot water, spot cooling units . . . gas air conditioning which regulates humidity . . . a single heat pump system which heats buildings or cools them as desired.

Controlling liquids and gases in miles-on-miles of tomorrow's piping will be thousands and thousands of Fairbanks Valves. They will have been selected because of topflight past performance . . . because architects and engineers know they can expect freedom from failure when a Fairbanks is installed.

Whether it's a small bronze valve or a huge iron body gate valve with a 24-inch opening the name Fairbanks stands for sound engineering, careful chemical and metallurgical control of alloys, ample metal for the job. The full line is given in catalog "42" which will be sent you if you ask for it. If you need special assistance with individual problems of valve selection and application, call on the facilities of the Fairbanks Engineering Department.



THE fairbanks COMPANY

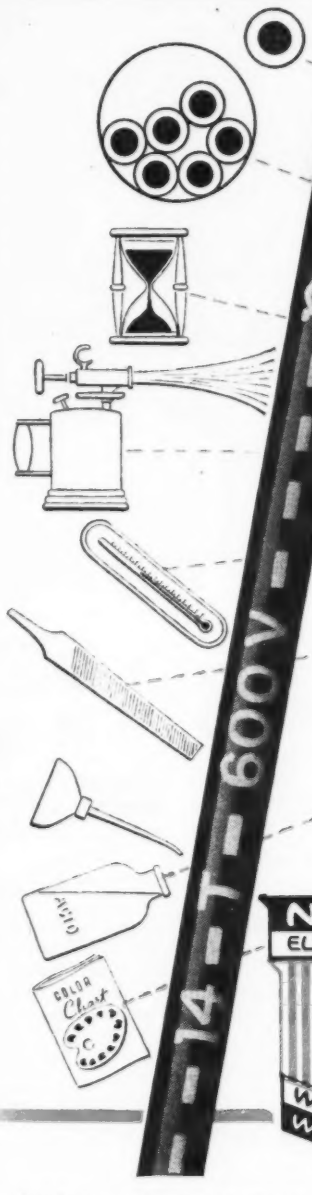
393 LAFAYETTE STREET, NEW YORK 3, N. Y.

520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.

TYPE T NE`ON

(thermo-plastic)

is a superior building wire (600 volts)



It offers these advantages over other types of electrical wiring:

- Superior dielectric properties, permitting minimum diameters.
- Greater number of Type T wires to the conduit, increasing wattage capacity as much as 212%.
- Better aging properties.
- Exceptional flame resistance.
- Approved for operating temperatures up to 60°C (140°F).
- Abrasion resistant—fibrous coverings unnecessary.
- High resistance to most acids and alkalies, alcohol, gasoline, oils and greases.
- Wide color range for easy identification. Permanent colors.

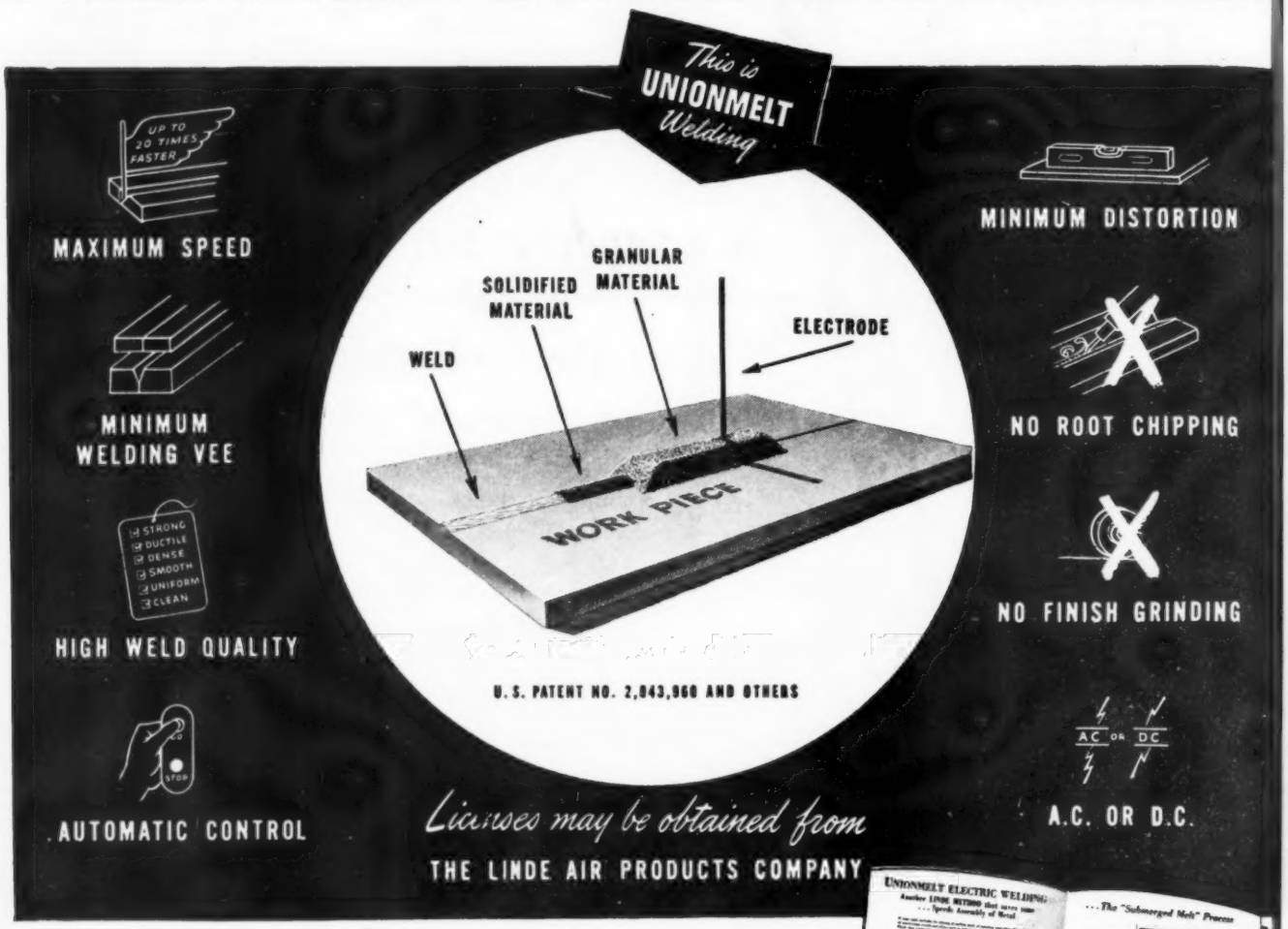
NATIONAL ELECTRIC PRODUCTS
NE
WIRING 6 SYSTEMS
WIRES AND CABLES

Available in all standard sizes up to 2,000,000 CM. Sizes 14 to 4/0 are approved by Underwriters' Laboratories. And for unusually moist locations, specify National Electric Type TW. Engineering data on request.

National Electric
PRODUCTS CORPORATION
Pittsburgh 22, Pa.

These are the advantages of Automatic UNIONMELT Electric Welding

A PROCESS OF WELDING ELECTRICALLY BENEATH A MINERAL MELT



Hundreds of manufacturers are now benefiting by the advantages of UNIONMELT Welding. It gives them top quality welds at speeds that are greater than with any other similarly applicable process.

If your work includes the joining of carbon steel, of stainless, and other alloy steels, or of non-ferrous metals and alloys such as nickel, copper, Monel, and Everdur, it is quite likely that UNIONMELT Welding can speed production, raise quality, and lower your costs.

Anyone who wishes to use this patented invention may do so under our standard license agreement. License fees are low and are based upon extent of use. Complete engineering assistance is available to licensees.

For additional information send for the folder *"Report No. 6 on the Use of Linde Methods in Mass Production"*—or ask a Linde representative to help you determine where you can use the UNIONMELT process advantageously.

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

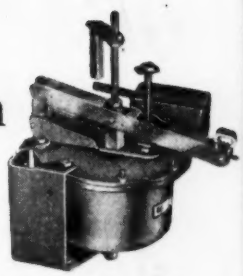
30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

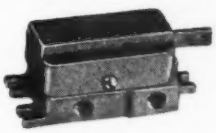
In Canada: Dominion Oxygen Company, Limited, Toronto

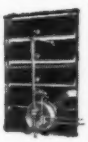
The word "Unionmelt" is a registered trade-mark of The Linde Air Products Company.

★ BUY UNITED STATES WAR BONDS AND STAMPS ★

REMEMBER the Gradutrol System of Pneumatic Control? Sure you do!



. . . But do you remember the important part the Gradutrol Relay  plays?

It produces precision control with positive positioning  of dampers or valves, and full modulation. Top power in either direction is available to overcome friction, but air consumption is reduced to a minimum . . .

Don't overlook the many important advantages of Gradutrol in those critical air conditioning process installations . . . Even the simplest job deserves Gradutrol. The added cost is negligible . . .

MINNEAPOLIS-HONEYWELL REGULATOR CO., 2702 Fourth Ave. S., Minneapolis 8, Minn. • Branches in all principal cities

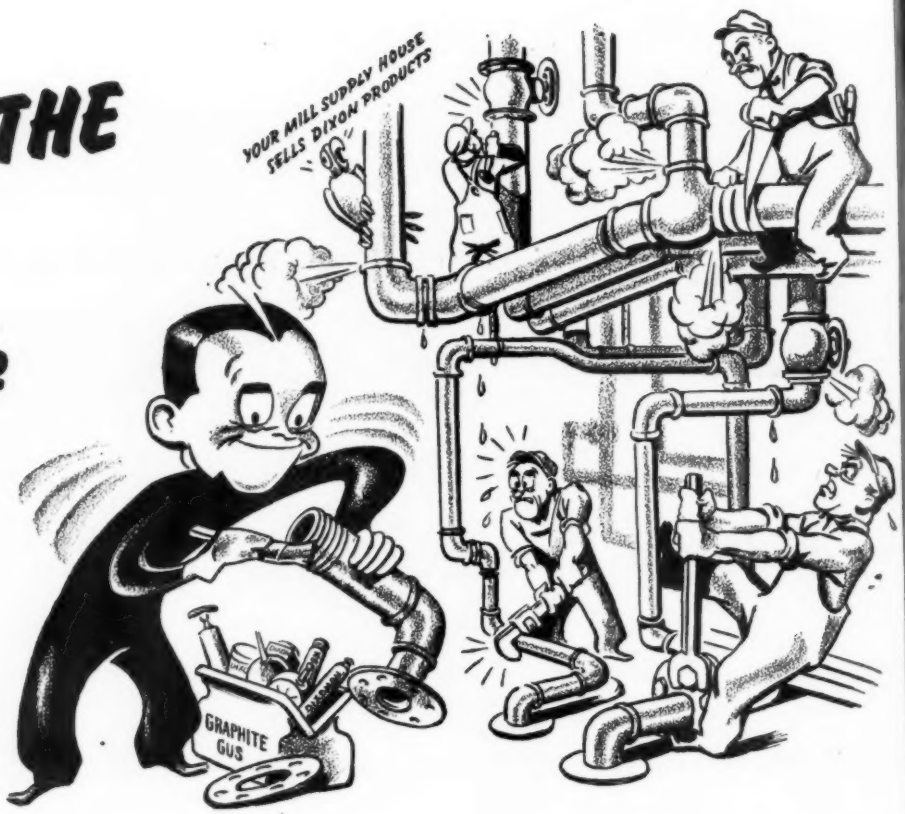
Keep them Winning —
Buy MORE War Bonds!

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

GRAPHITE GUS SAYS:

GRAPHITE THE "JOINT"

and save the headaches



These two joiners take the aches out of putting up piping, taking it down and keeping it leakproof

DIXON'S PIPE JOINT GRAPHITE COMPOUND

DIXON'S GRAPHITE SEAL

This superlative lubricant and permanent seal leak-proofs all joints against hot or cold water, steam, air, gas, aqueous solvents, acids and brines. It assures easy, quick assembly. In dismantling—even years later—it saves damage to gaskets, fittings, valves, etc. Wherever you need extra precaution against joint-failure get this heat-proof, corrosion-proof, non-setting Graphite pipe joint compound and save backaches and headaches. Read Data Sheet #21.

Tested and approved by the Underwriters Laboratories, this seal makes permanent leak-proof connections on all varieties of pipe lines and assemblies conveying hot or cold oil, gasoline and petroleum gases. It solidifies quickly, but its lubricating flake graphite content makes assembly and dismantling practically effortless. This saves time and money on fittings, gaskets, valves, etc. Read Data Sheet #22.

DIXON'S GRAPH-AIR GUN TYPE 4

Handily blows its contents of dry powdered Microfyne Graphite into locks and all close-fitting mechanisms. Provides long lasting lubrication that is exceptionally resistant to extremes of temperature. In shop, office and home it's the most useful lubricator ever. Read Data Sheet #8 for many of its 1001 uses. Buy a gun at your Supply or hardware store—30¢.

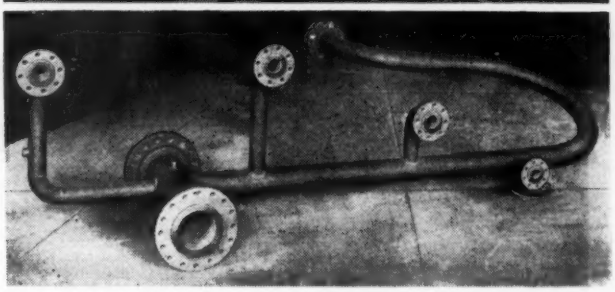
DIXON'S GRAPHITE
LUBRICATION - HEAT CONDUCTION
HEAT AND COLD RESISTANCE - ELECTRICAL CONDUCTION
PROTECTIVE COATINGS AND PAINTS

ANSWERS! HELPS! HINTS!

Want help in a tough pipe fitting or lubrication problem? Write Graphite Gus for these illustrated Data Sheets on the product or products that interest you. See how and where you can use Graphite to do a Better job.

JOSEPH DIXON CRUCIBLE COMPANY

DIV. 94C9 — JERSEY CITY 3, NEW JERSEY



MODERN *Shop Fabrication* OF PIPING MEANS LOWER c. p. y.

SHOP fabrication means work done under carefully controlled conditions, with facilities for careful and correct handling of large and awkward parts; it means facilities for every necessary test while the work is still in process; it means specialized craftsmanship, trained for the specific job being done.

Is it any wonder that users of complicated piping assemblies are depending more and more on Pittsburgh Piping and Equipment Company's facilities for bending, welding, flanging, Van Stoning, machining, heat treating, stress relieving, pressure testing and gamma ray inspection?

They generally find that the job installed costs less if sub-assemblies as large as transportation facilities permit are shop fabricated. They always find that the c.p.y. (cost per year) is materially less because of the scientific engineering, modern laboratory control and expert shop craftsmanship which have produced equipment that can take ordinary wear and extraordinary punishment.

BUY MORE WAR BONDS

Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

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Public Square Building, Cleveland
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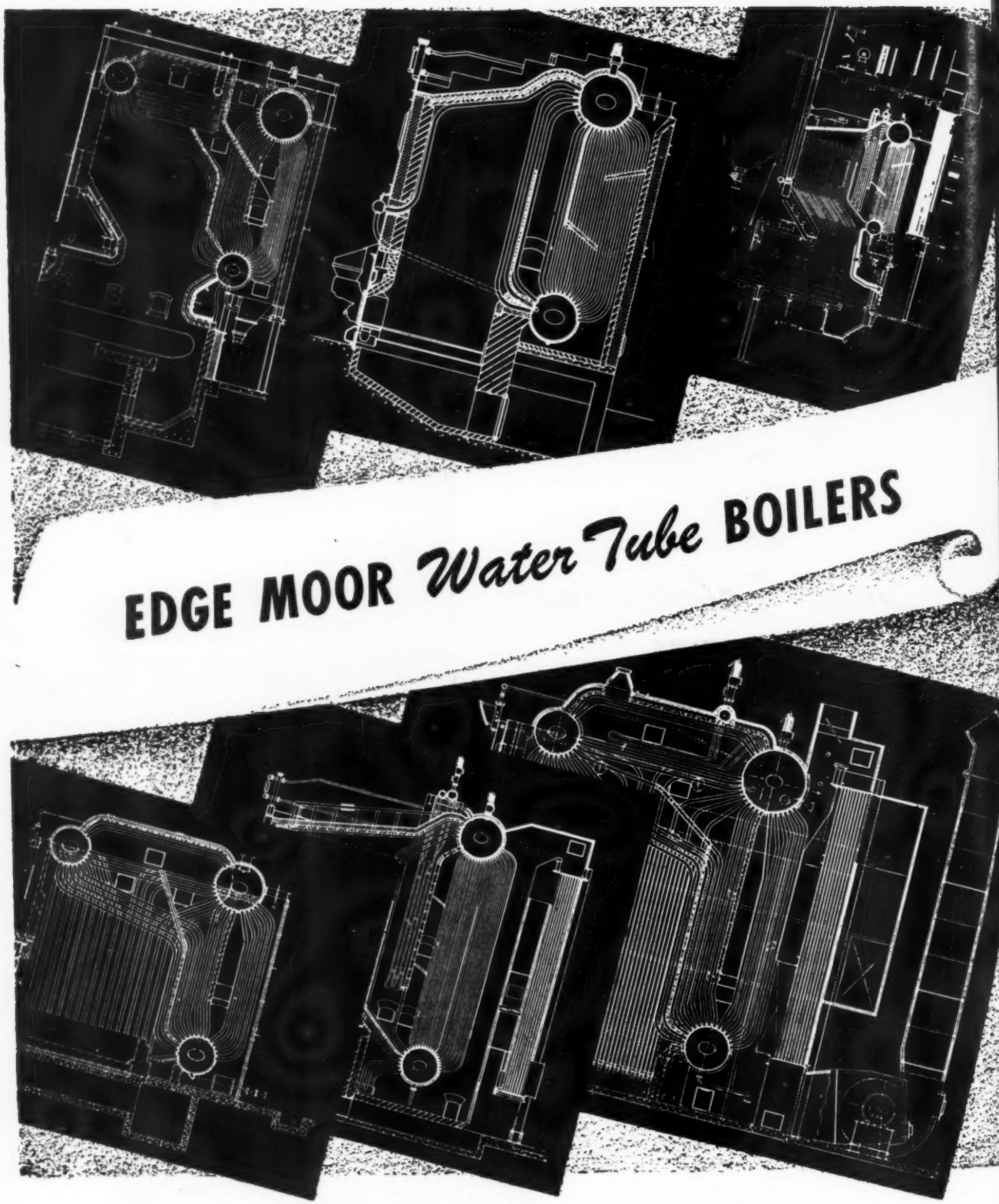
Heights State Bank Bldg., Houston
634 S. Gramercy Place, Los Angeles



EDGE MOOR *Water Tube* BOILERS

All designs of steam generators for any required capacity and up to 900 lbs. drum pressure are completely engineered and built at Edge Moor.

The combination of Edge Moor engineering and manufacturing control insures the ultimate in modern power plant construction.

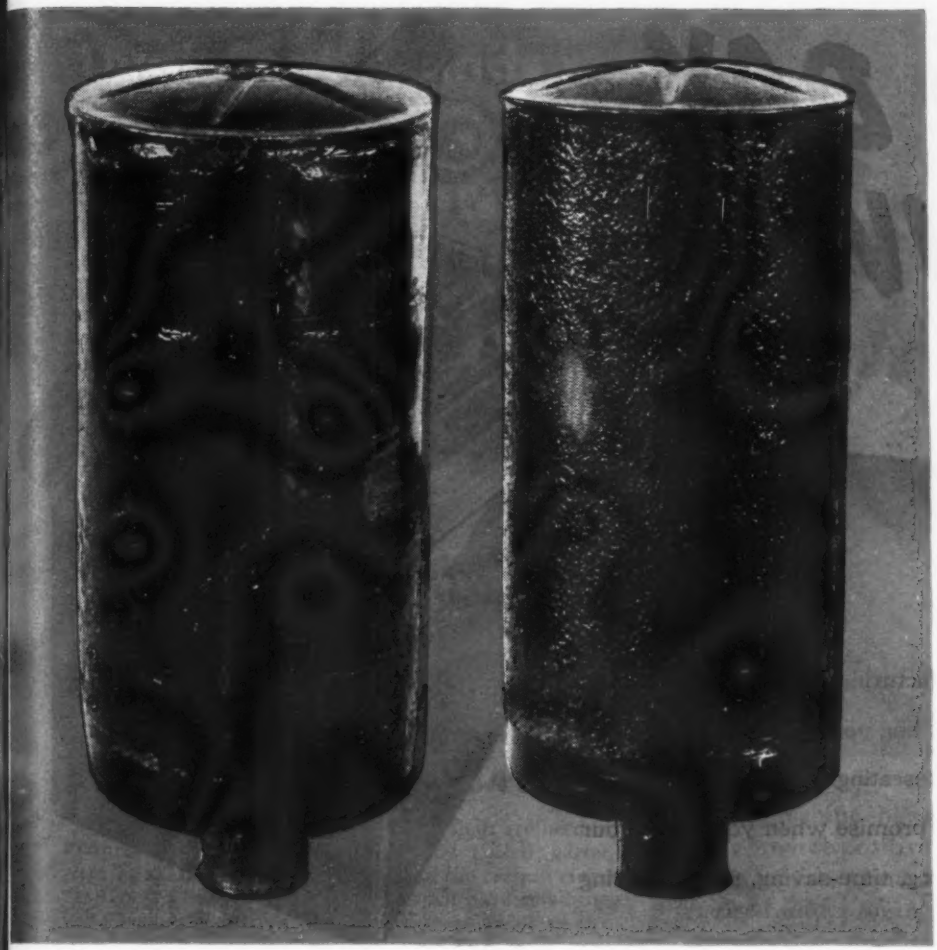
STEAM GENERATING EQUIPMENT

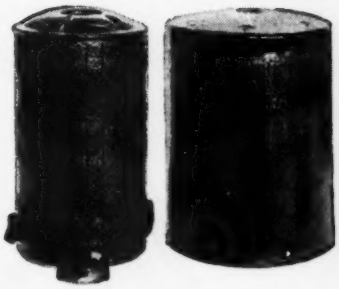
EDGE MOOR
IRON WORKS, INC.

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

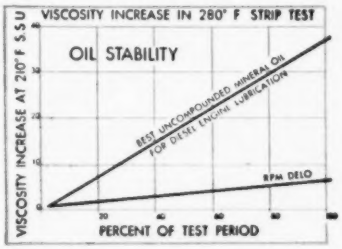
MAIN OFFICE: EDGE MOOR, DELAWARE

How RPM DELO OIL stops filter clogging





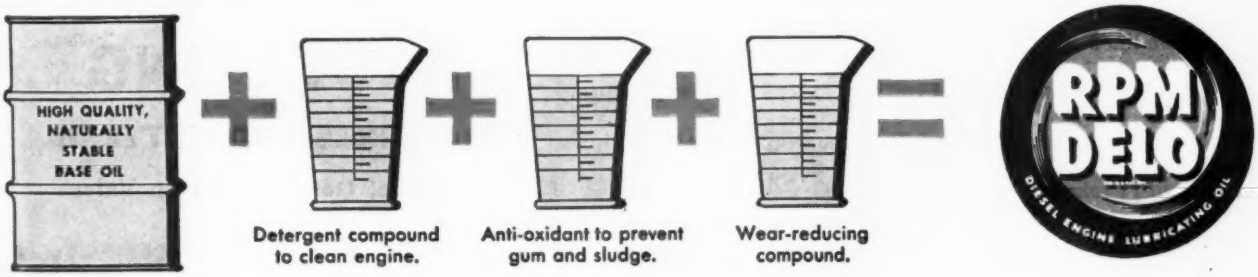
Powerful Anti-Oxidant effects of compounding material in RPM DELO Oil are graphically illustrated by cleanliness of this filter after 500-hour test under heavy duty conditions. Inherent stability of selected base stocks in RPM DELO Oil, plus detergent compounds assure minimum engine deposits, prevention of many costly shutdowns.


VISCOSITY INCREASE IN 280° F STRIP TEST
OIL STABILITY
VISCOSITY INCREASE AT 210° F S S U
BEST UNCOMPOUNDED MINERAL OIL FOR DIESEL ENGINE LUBRICATION
RPM DELO
PERCENT OF TEST PERIOD

This Is How uncompounded oil clogged a regular commercial filter element after only 204 hours in a test run. The shiny sludge deposit is the result of oxidation of oil, plus iron, silica and water. In actual use, a clogged filter can result in stopped-up oil passages and excessive crankcase sludge, necessitating expensive overhauls for cleaning.

Same Type Filter from the same engine, operated on RPM DELO Diesel engine lubricating oil looked like this after 1234 hours. There is little deposit, oil flow is unimpaired. RPM DELO Oil prevents filter clogging two ways: 1. By maintaining piston rings in free working condition. 2. By minimizing oxidation of oil itself.

How RPM DELO Oil resists oxidation far more effectively than other oils is shown in this chart. Results were based upon increase of viscosity during severe laboratory tests. Write Dept. T-X, Standard of California, San Francisco 20, Calif., for more technical information on RPM DELO Diesel Engine Lubricating Oil.


HIGH QUALITY, NATURALLY STABLE BASE OIL
Detergent compound to clean engine.
Anti-oxidant to prevent gum and sludge.
Wear-reducing compound.
RPM DELO
DIESEL ENGINE LUBRICATING OIL

STANDARD OF CALIFORNIA

RPM DELO Oil has world-wide distribution under the names: RPM DELO, Caltex RPM DELO, Signal RPM DELO, Imperial RPM DELO (CONCENTRATE)

60 DAY DELIVERY!

As our non-military manufacturing facilities catch up with our back orders, it is becoming possible to give faster deliveries on Dexter Valve Reseating machines and cutters. "60 days or better" is our promise when you place your order for this money-saving, time-saving, trouble-saving valve-reseating outfit.

When you realize that the Dexter equipment can reseat any water, oil, steam or air valve right in its place on the line in just a few minutes, you begin to see the amazing possibilities of this outfit. Then when you consider that the reseated valve is actually a better performer than a new one, you'll want to order your Dexter in a hurry.

No more expensive maintenance crews needed for valve replacement — no more long shutdowns for valve repairs while lines are broken — no more wasteful losses of steam, oil, air or water — because the Dexter Valve Reseating Machine eliminates them all. Once you've used it, money couldn't take it back.

Write us about your leaky valve problems. If you give make of valve, size, type, use and pressure, we'll prescribe the remedy. No obligation, of course.

DEXTER VALVE RESEATING

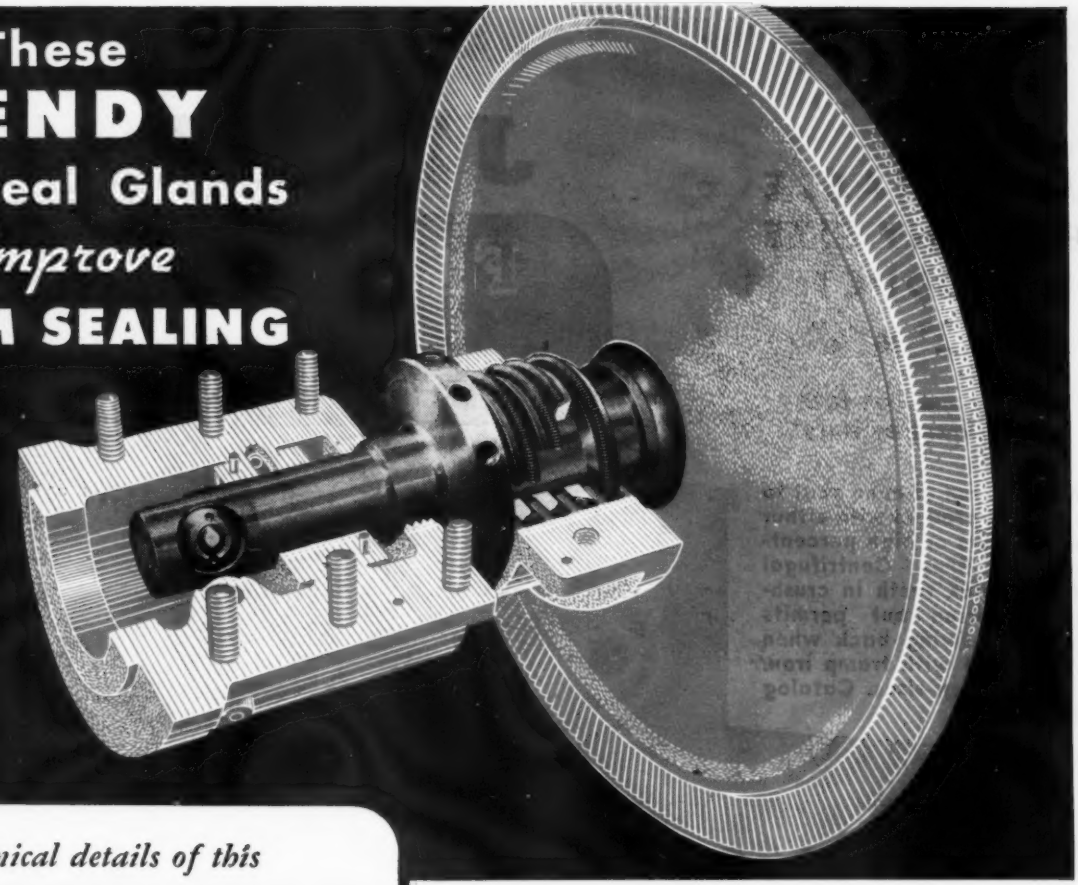
MACHINES AND CUTTERS

for Globe, Gate and Pump Valves

25

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

These HENDY Dual-Seal Glands *Improve* STEAM SEALING



Technical details of this

HENDY TURBINE FEATURE

Carbon seals at each end of the rotor shaft are held in contact with the grooved walls by coiled garter springs. The outer surface of each of the carbon rings is tapered in such a way that the spring, in retaining the ring, also forces it against one sidewall of the groove. The ring is thus positioned and supported; it cannot "ride" the shaft.

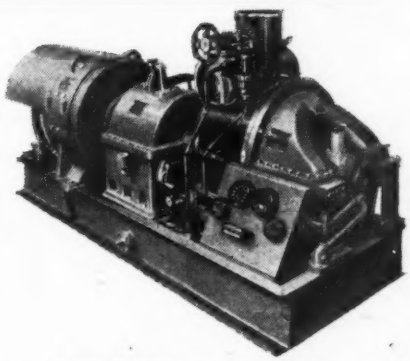
At the same time, the spring holds together the three segments of the carbon ring, maintaining a close clearance between shaft and ring. Sealing is thus accomplished at *both* the shaft and the sidewall, greatly increasing the sealing surface of each ring.

The housings for the carbon rings are split on the center line of the shaft, and may be removed without disturbing other parts of the turbine cylinder. This simplifies inspection or servicing of the glands.

Hendy turbine shafts are fitted with carbon gland rings that provide positive *side sealing* as well as *shaft sealing.* This construction reduces the number of rings required and prevents excessive leakage. In addition, this dual-sealing feature *minimizes shaft drag,* which can cause both shaft heating and excessive ring wear.

Refinement of design is characteristic of Hendy turbo-generators. Other advancements include a simplified governing system that results in accurate speed regulation . . . a new type of labyrinth seal between rotor disks that reduces interstage steam leakage . . . placement of oil filters, coolers, strainers, and other accessories that simplifies external piping. Details of these features are available upon your request.

Hendy turbo-generators are available for marine and industrial applications—direct drive or reduction gear, depending upon requirements—in sizes from 250 kw up. You are invited to submit your power-plant problems to Hendy engineers—phone or write your nearest Hendy office.



Shown at right is the model HG-26 Hendy 300-kw turbo-generator. Large numbers of this type are being supplied for service on Navy and Maritime Commission vessels.

JOSHUA HENDY IRON WORKS

ESTABLISHED 1856

SUNNYVALE, CALIFORNIA

Branch Offices: WASHINGTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • NEW YORK • LOS ANGELES • DETROIT • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • BOSTON

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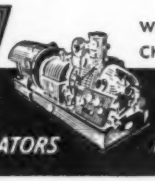


TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES

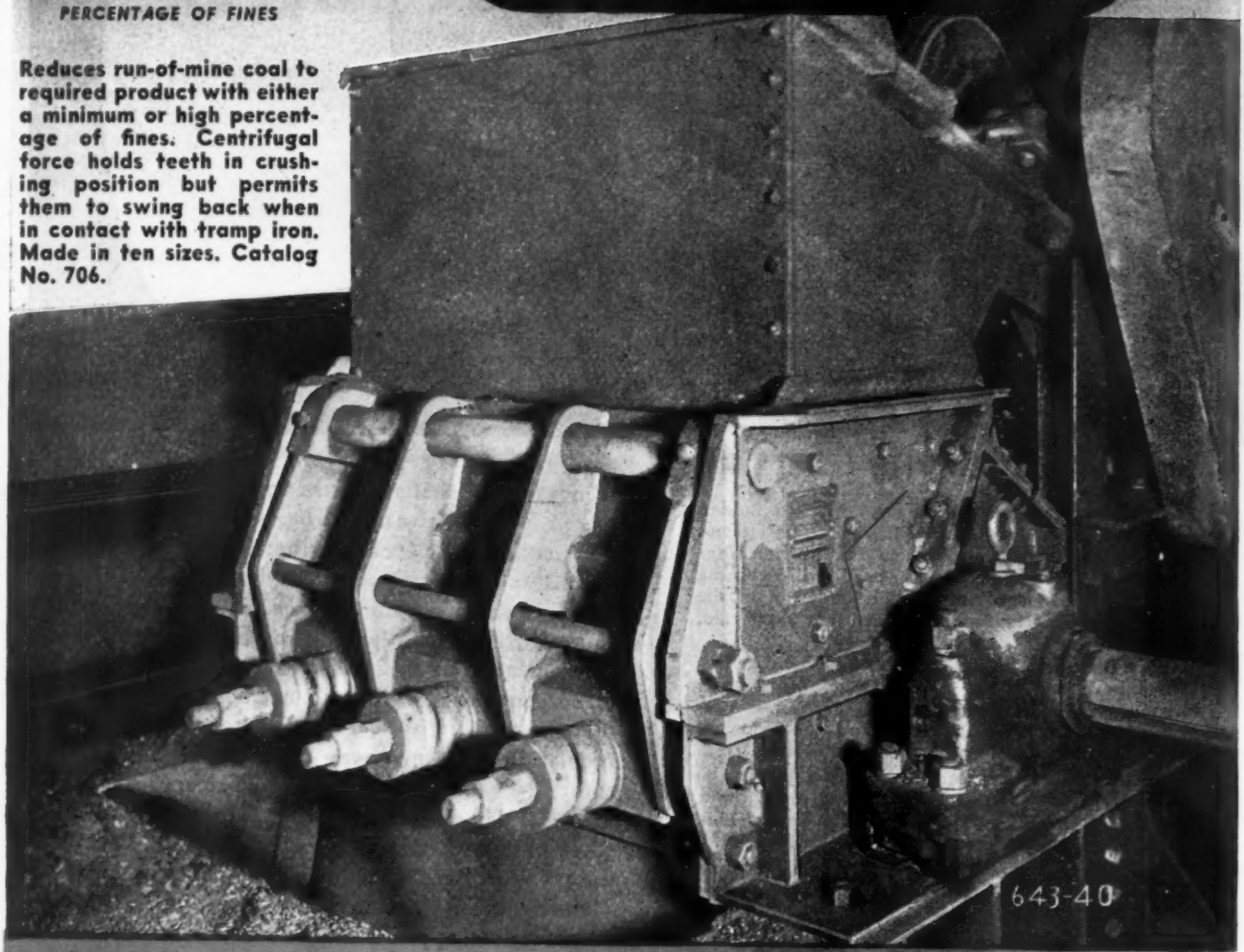
JEFFREY

FLEXTOOTH
(PATENTED)
CRUSHER

ADJUSTABLE FOR ANY SIZE PRODUCT from 2" to ¼"

EITHER HIGH OR LOW PERCENTAGE OF FINES

Reduces run-of-mine coal to required product with either a minimum or high percentage of fines. Centrifugal force holds teeth in crushing position but permits them to swing back when in contact with tramp iron. Made in ten sizes. Catalog No. 706.



THE JEFFREY MANUFACTURING COMPANY

ESTABLISHED 1877

932-99 North Fourth St., Columbus 16, Ohio

Baltimore 1 · Buffalo 2 · Cleveland 13 · Harlan · Milwaukee 11 · Pittsburgh 22
Birmingham 3 · Chicago 1 · Denver 2 · Houston 5 · New York 7 · St. Louis 3
Boston 16 · Cincinnati 2 · Detroit 13 · Huntington 19 · Philadelphia 3 · Salt Lake City 1
Scranton 3

"LOW STEAM CONSUMPTION MAINTAINED"

reports the city of Corbin, Ky., of their 1500 KW Worthington-Moore Turbine Generator.

GEO. W. JENKINS
Commissioner of Finance

BERT ROWLAND, Mayor

Power and Water Department
CITY OF CORBIN
H. C. CRAFT, Superintendent
Corbin, Kentucky

JOHN V. WALKER
Commissioner of Public Works

Worthington Pump and Machinery Corporation
Eight and Race Streets
Cincinnati 1, Ohio

Dear Sir:

Attention-Mr Earle W. Vianedge
Manager
Cincinnati District Office

You will recall that when our 1500 KW turbine generator unit which we purchased from Worthington was installed 4½ years ago it was necessary for us to immediately put it in service due to load demands without the usual tune up period. Since then the unit has been in practically continuous service and now that we are in a position to do so we have decided to open the turbine for inspection.

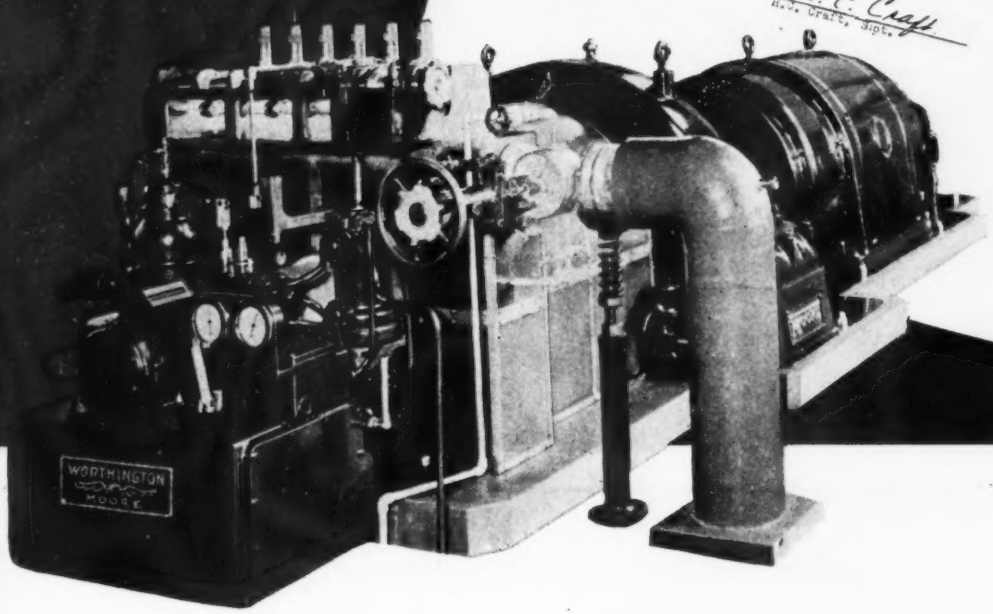
We believe that you will be interested to know that except for routine adjustments maintenance has been negligible and the original low steam consumption has been maintained. We are very pleased with the service and economical operation this unit has given us and the interest you have shown.

Yours very truly,

CITY OF CORBIN
POWER and WATER DEPT.

MF/HCC

H. C. Craft, Supt.



Low maintained steam consumption, freedom from operating troubles and the ability to be placed in continuous service immediately after erection without a "tune-up" period are typical characteristics of all Worthington Turbine Generator units. This is made possible by our practice of testing the complete unit under operating steam conditions and load at our works before shipment . . . Write today for Bulletin 1960 . . . further proof that *there's more worth in Worthington*. *Worthington Pump and Machinery Corporation*, Moore Steam Turbine Division, Wellsville, N. Y.

WORTHINGTON

T5-2

A GREAT TEAM IN STEAM

Year-'round Temperatures in Each Room Controlled Separately

"The *first* Mutual Life Insurance Company chartered in America—1835." A century later, New England Mutual expanded its offices for a fourth time. Three years of exhaustive research and planning by committees of directors, home office executives, architects and builders preceded construction. Visits were made to manufacturers' plants and laboratories, countless installations of modern equipment were tested and the experience of other users was checked. Such vigilance and study led to the selection of Johnson *Individual Room* Control of temperatures. Similar decisions have been made for building after building across the nation.

A total of 240 Johnson *Dual* Thermostats, at New England Mutual, operate valves and dampers in 575 blending units which deliver conditioned air the year around. A total of 77 concealed auxiliary radiators and the seven central air conditioning supply and exhaust systems also are Johnson controlled. Each *Dual* thermostat is arranged to maintain either of two temperatures, at the will of the occupant—a normal "occupancy" temperature and a lower "economy" temperature for non-occupancy hours . . . The result is that the cost of steam has been considerably lower than the original estimates.

Johnson is a nation-wide organization designing, manufacturing and installing automatic temperature control systems. Many years of specialized experience qualify Johnson engineers to assist *your* heating and air conditioning engineer and contractor in solving control problems. There is a Johnson direct branch office near-by. A consultation does not obligate you. Ask us now to indicate how we can be of service. JOHNSON SERVICE COMPANY, MILWAUKEE 2, WISCONSIN. Direct Branch Offices in Principal Cities.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

DESIGN • MANUFACTURE • INSTALLATION • SERVICE

YOU HAVE or . . . probably are, making plans for new equipment as soon as it becomes available . . . In these plans of yours take a critical look at your power plant. Ask yourself these questions . . .

	YES	NO
Is it economical in size?	☐	☐
Can it use any liquid fuel?	☐	☐
Is it protected against low water?	☐	☐
Is it protected against flame failure?	☐	☐
Is it protected against over-pressure?	☐	☐
Is it simple and easily accessible?	☐	☐

If your power plant equipment does not rate a score of 100% on the above quick-quiz, get in touch with us because the improved (and it has been improved and simplified) Amesteam Generator will do all this and . . . more!

The Amesteam Generator is a portable packaged unit that requires no large amount of space (as compared to the conventional fire tube type boiler). It requires no expensive stack. All you do after delivery is connect the water, fuel, electricity, and steam . . . then . . . push the button!

Naturally we have more detailed information and specifications which we'll gladly send . . . just write us today.

WHAT SIZE DO YOU NEED	
No.	H.P.
A-10	10
A-15	15
A-20	20
A-30	30
A-40	40
A-50	50
A-60	60
A-70	70
A-80	80
A-100	100
A-125	125
A-150	150
A-200	200
A-250	250
A-300	300

AMESTEAM GENERATORS

AMES IRON WORKS

OSWEGO • NEW YORK

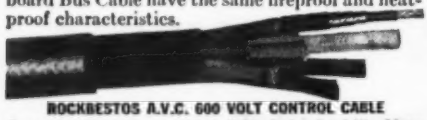
For Severe Conditions

Permanently Insulated ROCKBESTOS Wires, Cables and Cords

ROCKBESTOS A.V.C. 600 VOLT SWITCHBOARD WIRE
(National Electrical Code, Type AVB)

Sizes No. 18 to No. 4/0 AWG with varnished cambric and impregnated asbestos insulation and gray, black, white or colored flameproof braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A.V.C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

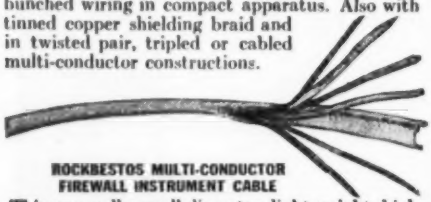
In one to 19 conductors with individuals insulated like Motor Lead Cable, cotton braid covered and cabled with an asbestos braid over all. Standard strandings AWG No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes manufactured for use in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

ROCKBESTOS FIREWALL RADIO HOOKUP WIRE

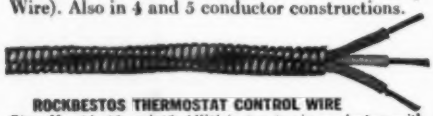
Sizes No. 22 to 4 AWG in 1000 volt rating, and No. 12, 14 and 16 AWG in 3000 volt insulated with high dielectric synthetic tape, impregnated felted asbestos and covered with color coded lacquered glass braid.

The first small diameter heat and flame resistant high-dielectric hookup wire, designed in 1937 and approved by the C.A.A. for use in airborne radio equipment. Widely used since in automotive and ground communications systems, electronic devices and apparatus. Operating temperature range 125° C. to minus 50° C. Ideal for small motor, coil, transformer and dynamotor leads and bunched wiring in compact apparatus. Also with tinned copper shielding braid and in twisted pair, tripled or cabled multi-conductor constructions.



ROCKBESTOS MULTI-CONDUCTOR FIREWALL INSTRUMENT CABLE

This unusually small diameter, light weight, high-dielectric 3 conductor No. 26 AWG cable, with individuals insulated like our Radio Hookup Wire, was designed for an electronic device in which three No. 22 AWG single conductor aircraft wires proved too bulky. It is made to a nominal diameter of .125" (smaller than a 14 AWG single conductor 1000 volt Rockbestos Firewall Radio Hookup Wire). Also in 4 and 5 conductor constructions.



ROCKBESTOS THERMOSTAT CONTROL WIRE

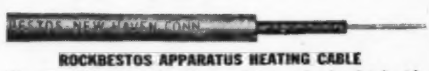
Sizes No. 14, 16 and 18 AWG in two to six conductors with .0125", or .025" or (for 115 volt service) .031" of impregnated felted asbestos insulation and steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal, and temperature control systems. Lifetime heatproof, fireproof insulation and rugged steel armor give troubleproof circuits.

ROCKBESTOS ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of Rockbestos A.V.C. Motor Lead Cable will complete the failure-proofing.



ROCKBESTOS APPARATUS HEATING CABLE

No. 19 AWG nickel-chromium resistance wire insulated with .040" of impregnated felted asbestos and covered with 4/64" waterproof lead sheath.

Manufacturers of photographic developing tanks, dry print developing machines, candy making equipment, soil heating cable kits and other devices requiring controlled distribution of mild heat can use this pliable heating cable to advantage. Also useful in preventing freezing of water pipes and congealing of oil, grease, ink, paint and sluggish fluids in conveyor pipes.

ROCKBESTOS 300 VOLT HEAT RESISTING FIXTURE WIRE
(Underwriters' Type AF)

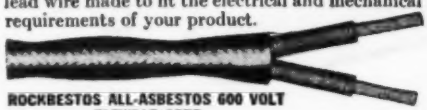
Sizes No. 10 to 18 AWG stranded plain copper conductor insulated with black or white impregnated felted asbestos—with or without braid.

Rockbestos asbestos insulated fixture wires, approved by the Underwriters' Laboratories, are ideal for lighting fixture wiring because their heat resistant insulation will not bake out under the high socket temperatures developed in modern fixtures. Also used for small motor leads, miniature switchboards, business machines, radios, etc.

ROCKBESTOS ALL-ASBESTOS APPLIANCE LEAD WIRE

Sizes No. 8 to 20 AWG solid or stranded copper, monel or nickel conductors insulated with .031" or .040" of impregnated felted asbestos in black, white or colors.

Whether you make waffle irons, hot-plates, small motors, ranges, water heaters, radios, ovens or blueprint machines, we can give you an asbestos lead wire made to fit the electrical and mechanical requirements of your product.



ROCKBESTOS ALL-ASBESTOS 600 VOLT FLEXIBLE CORD

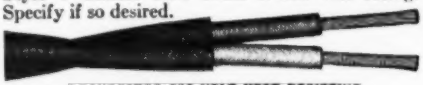
Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos and covered with a heavy asbestos braid.

This heavy duty heat-resisting flexible cord is ideal for high wattage lighting units, apparatus, floodlights, etc., that are used in hot spots or develop heat in operation. For moisture resistant type specify the Rockbestos A.V.C. construction described below.

ROCKBESTOS A.V.C. 600 VOLT FLEXIBLE CORD

Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos, varnished cambric, felted asbestos and covered with a heavy impregnated asbestos braid.

For applications such as mentioned above in which heavy duty, high-dielectric, heat and moisture resistant flexible cord is required we recommend this construction with individual conductors insulated exactly like Rockbestos A.V.C. Motor Lead Cable. Approved for lighting applications, with polarized conductors, by Underwriters' as Style V flexible cord under a 300 volt rating. Specify if so desired.



ROCKBESTOS 300 VOLT HEAT RESISTING DUPLEX FLEXIBLE CORD
(Underwriters' Type AFPD)

Sizes No. 10 to 18 AWG stranded plain copper conductors insulated with impregnated felted asbestos, polarized, twisted together and covered with a cotton braid.

This duplex heat resisting flexible cord is approved by the Underwriters' Laboratories for use in fixtures and is recommended for pendant types as the asbestos insulation will not dry out or crack at the socket. It provides protection against wire-failure, eliminates fire-hazard and gives permanent suspension as it does not deteriorate with heat or age. Also in twisted pair, tripled and triplex.

ROCKBESTOS A.V.C. 600 VOLT MOTOR LEAD CABLE
(National Electrical Code, Type AVA)

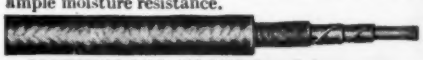
Size No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated asbestos and a high-dielectric varnished cambric insert, with a heavy asbestos braid overall.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA)

Sizes No. 18 AWG to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid. Other constructions for service voltages to 5000.

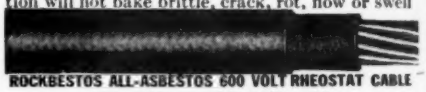
Use Rockbestos A.V.C. Power Cable for the internal wiring and power leads of heat-exposed heavy electrical equipment and hot-spot wiring in conduit around boiler rooms, steam lines, furnaces, etc., as it withstands high temperatures and has ample moisture resistance.



ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(National Electrical Code, Type AVA)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell



ROCKBESTOS ALL-ASBESTOS 600 VOLT RHEOSTAT CABLE
(National Electrical Code, Type AI)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For flexible stranded conductor specify Rockbestos All-Asbestos Flexible Apparatus Cable. For solid conductor specify Rockbestos All-Asbestos Rheostat Wire.

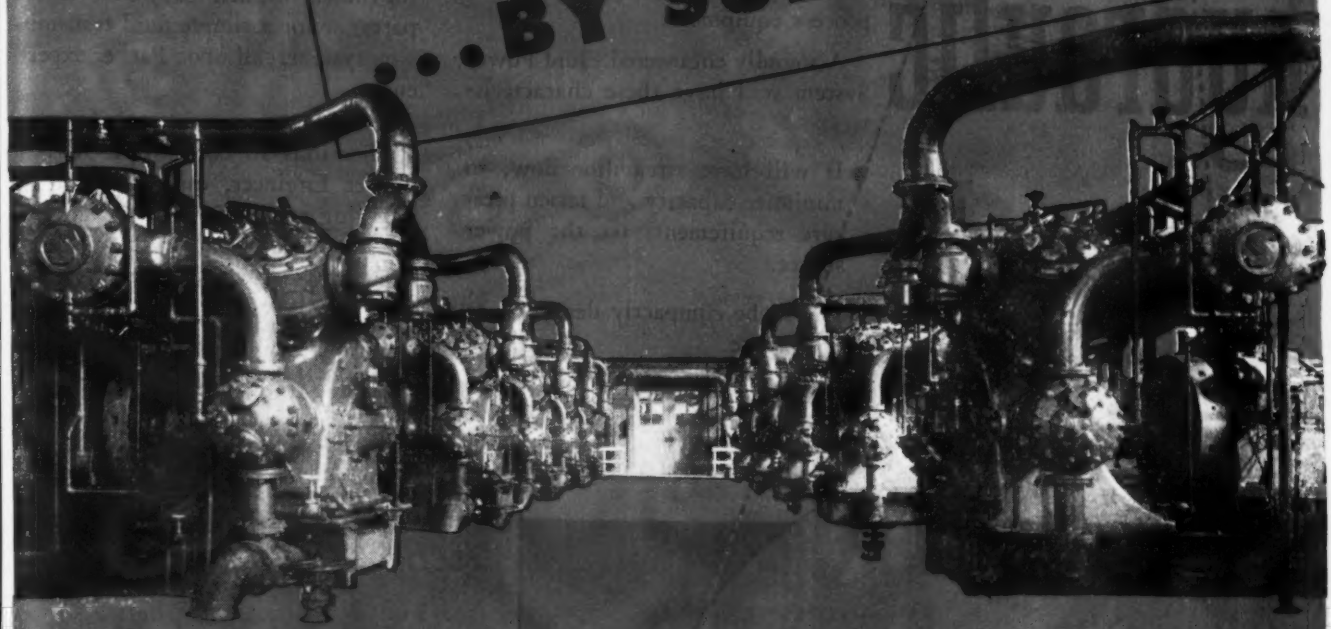
A few of the National Electrical Code types (listed by Underwriters' Laboratories) and other constructions in the Rockbestos line of 125 different *permanently insulated* wires, cables and cords designed to give long-lived, dependable service in electrical products — all built to resist such wire-destroying hazards as heat, moisture, oil, grease, corrosive fumes and flame. For complete information or samples write to:

Rockbestos Products Corporation
103 Nicoll St., New Haven 4, Conn.

RESIST Heat, Moisture, Oil, Grease And Fumes WON'T Bake Brittle, Bloom, Burn or Rot

AIR POWER

...BY SULLIVAN



A recognized leader in the air compressor industry, Sullivan has pioneered in the development of all types of air power. Sound engineering design, better materials and finer workmanship have produced air equipment which most of the prominent industrial firms in America have selected . . . a tribute to Sullivan dependability, economy and efficiency. Sullivan gives you air compressor superiority that comes from over 94 years experience with air power problems all over the world. If the job is done with air . . . you can do it better with Sullivan Air Equipment. Sullivan Machinery Co., General Offices: Michigan City, Indiana. In Canada: Canadian Sullivan Machinery Co., Ltd., Dundas, Ontario.

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DES[illegible]OR

hydraulic control

Hydraulics have proved ability to control machine operations—with pressures in pounds or tons, with high precision and high speeds—

There is only one "if"—the system of tubing, fittings and valves must be properly engineered. Here at Parker we call that job Fluid Power Engineering, and we've been at it for 20 years, on aircraft, motor vehicles, machine tools, refrigeration and process equipment.

A soundly engineered Fluid Power System will have these characteristics:

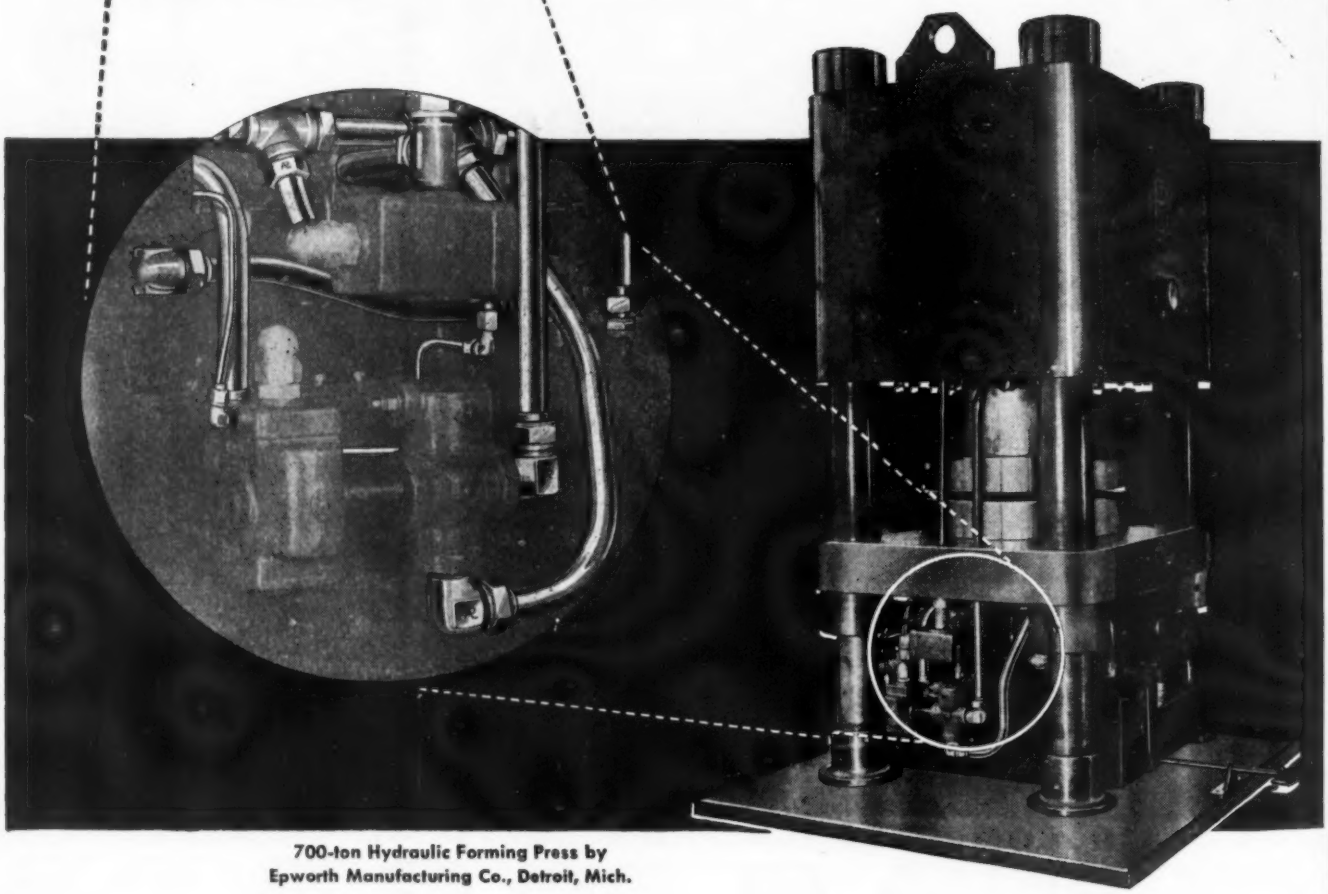
- It will have streamline flow, to minimize capacity and lessen pressure requirements on the power source.
- It will be compactly designed, to save space.

All parts will be accessible, for easy and quick service and maintenance.

It will have the minimum number of joints and connections, to guard against leaks, even under conditions of high pressure, vibration shock, fluid hammer and surge, or accidental abuse.

For the design of such a system, and for the valves, fittings and fabricated parts, or for a simple fluid transmission system, call upon Parker experience.

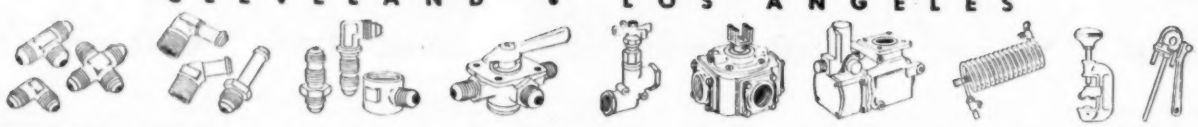
For your present uses, or for new applications to come, talk with a Parker Engineer, especially in the planning stage. You'll save money, and be more certain of satisfactory results. Write to The Parker Appliance Co., 17325 Euclid Avenue, Cleveland 12, Ohio.



700-ton Hydraulic Forming Press by
Epworth Manufacturing Co., Detroit, Mich.

THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES



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Pipe Pre-Fabrication is a Fine Art

Modern pipe fabrication is much more than the routine combining of bends, fittings, flanges, welds, etc. It is a fine art requiring a high degree of skill and judgment on the part of many specialists—skill and judgment which come only from long experience.

Engineers must know how to get the desired result in the most economical way—must be able to plan sub-assemblies which are practical and reduce field work to a minimum. Pipe benders must be masters of a difficult art: bending without flattening or wall thinning or metal deterioration. Pressure piping welders must be qualified on different materials and on various procedures. Men who do aligning, heat treating, testing, etc. must all have their special qualifications.

Qualified pipe fabricators have the advantage of permanent organizations containing men who have these qualifications. As a result, piping pre-fabricated by a qualified fabricator is better in quality, easier to erect and insures fulfillment of all intents of the design.

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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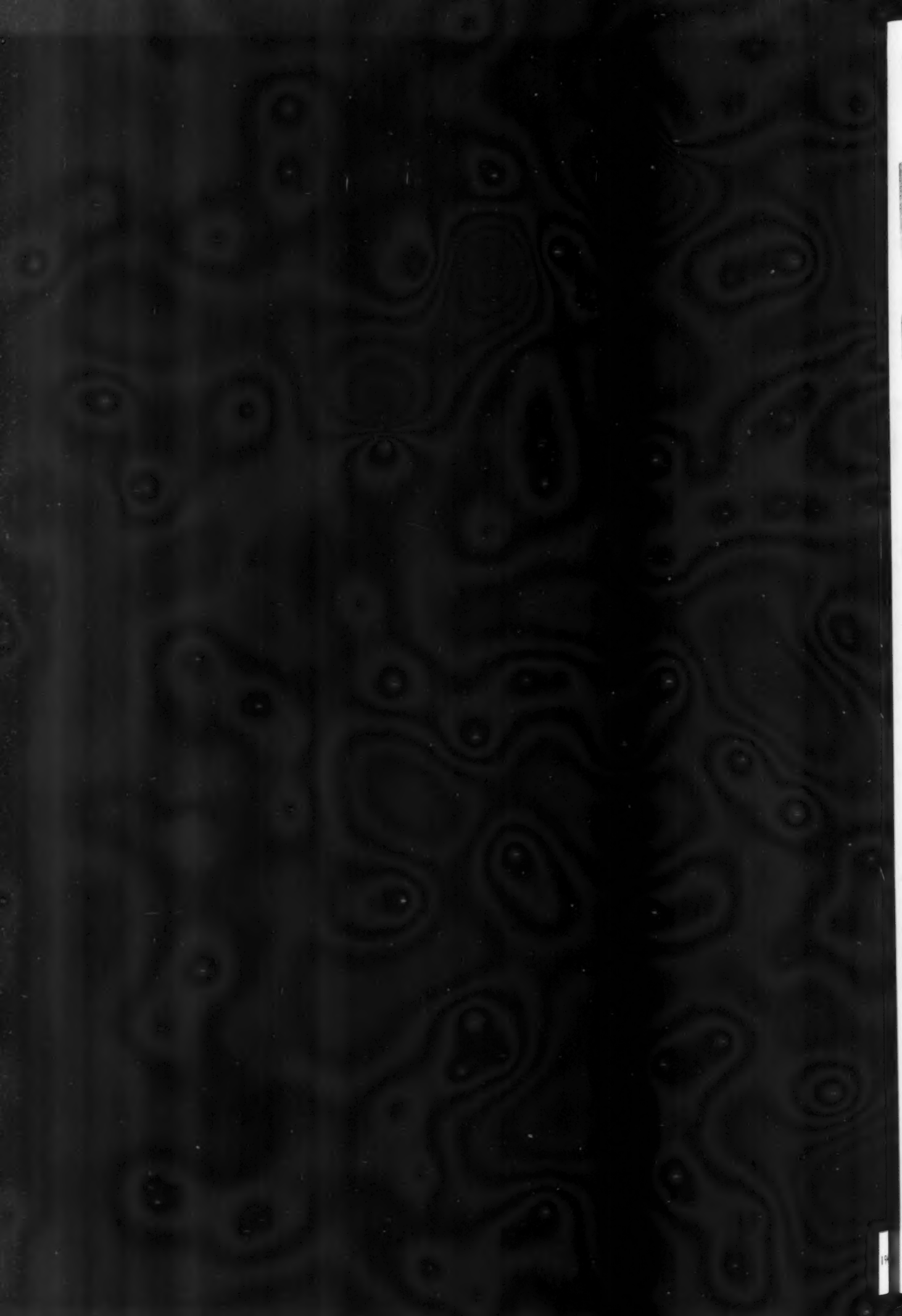
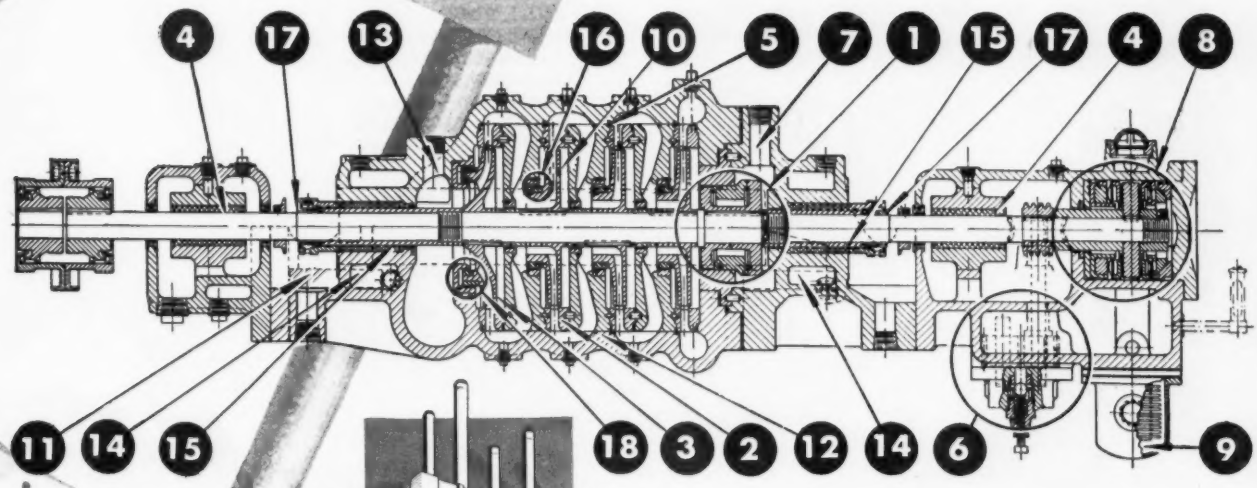
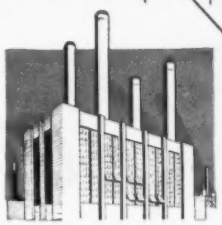
THE WICKES BOILER COMPANY • SAGINAW, MICHIGAN



Pacific *Outstanding* Features





model JB Boiler Feed Pump

1. **PACIFIC PATENTED FLOATING SEAL**—Hydraulically-Balanced — Non-Seizing — Balances lateral thrust of Rotating Element—Reduces pressure on Discharge Stuffing Box to suction pressure.
2. **DIFFUSERS**—Efficiently convert velocity energy to pressure energy—Assure perfect radial balance.
3. **MIXED-FLOW FIRST-STAGE IMPELLER**—Eliminates flashing—Assures continuous operation on high temperature with low n.p.s.h.
4. **SHORT BEARING CENTERS AND HEAVY SHAFT**—Provides rigidity and assures smooth operation. Shaft is protected throughout.
5. **POSITIVE STAGE-TO-STAGE SEAL**—Seals Face to Face
6. **PRESSURE LUBRICATION**—For Radial and Thrust Bearings—Provided by Gear-Type Lube Oil Pump driven from Main Pump Shaft.
7. **BY-PASS FROM SEAL**—Returned direct to Heater—A positive safeguard in reducing dangerous temperature increases should the Pump load drop suddenly to a very small flow No external By-Pass Orifice or Control Valves required.
8. **"KINGSBURY" THRUST BEARING**—Furnished to Specifications
9. **INTEGRAL APPROVED-TYPE OIL COOLER**—Of Ample Capacity.
10. **DYNAMICALLY-BALANCED IMPELLERS**—Eliminate vibration and wear—Increase life—Maintain efficiency.
11. **PUMP FEET LOCATED CLOSE TO CENTER-LINE**—Eliminates expansion misalignment.
12. **SMALL DIAMETER CASING**—Heavy symmetrical section—Close bolting—Assures tight joint.
13. **SUCTION VENT**—At eye of first-stage Impeller prevents vapor binding.
14. **PACKING HOUSINGS**—Water-Cooled—Insures long life—Trouble-free packing service.
15. **STUFFING BOXES**—Extra-Deep—with renewable throats
16. **RENEWABLE CASE AND IMPELLER WEARING RINGS**—Low maintenance cost for restoring initial clearance.
17. **SHAFT SLEEVE TO SHAFT PACKING**—Prevents leakage.
18. **DOUBLE WEARING RING**—Reduces Leakage

RATING—
Designed for speeds up to 5000 R.P.M.
Sizes—1½" to 6"
Capacities—up to 1600 G.P.M.
Differential Pressures—up to 1000 lbs.
Operating Temperatures—up to 500°F.

PACIFIC PUMPS INC., Huntington Park, Calif.

One of the Dresser Industries

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PACIFIC *Engineered* PUMPS

To Men Who Know Motors

. . . we could end our message here!

To men who know motors, a picture like this is worth the proverbial ten thousand words. It speaks with convincing eloquence of craftsmanship to which any motor builder could point with pride.

If you visit Star's modern plant, you'll see scores of examples of the same painstaking craftsmanship that pays off in outstanding performance for Star customers.

Star not only builds motors well, but also takes leadership in design. Star pioneered ball bearing motors . . . led in welded steel construction . . . developed the famed Star Built-in Magnetic Disc Brake for motors . . . pioneered in the field of gear-motors.

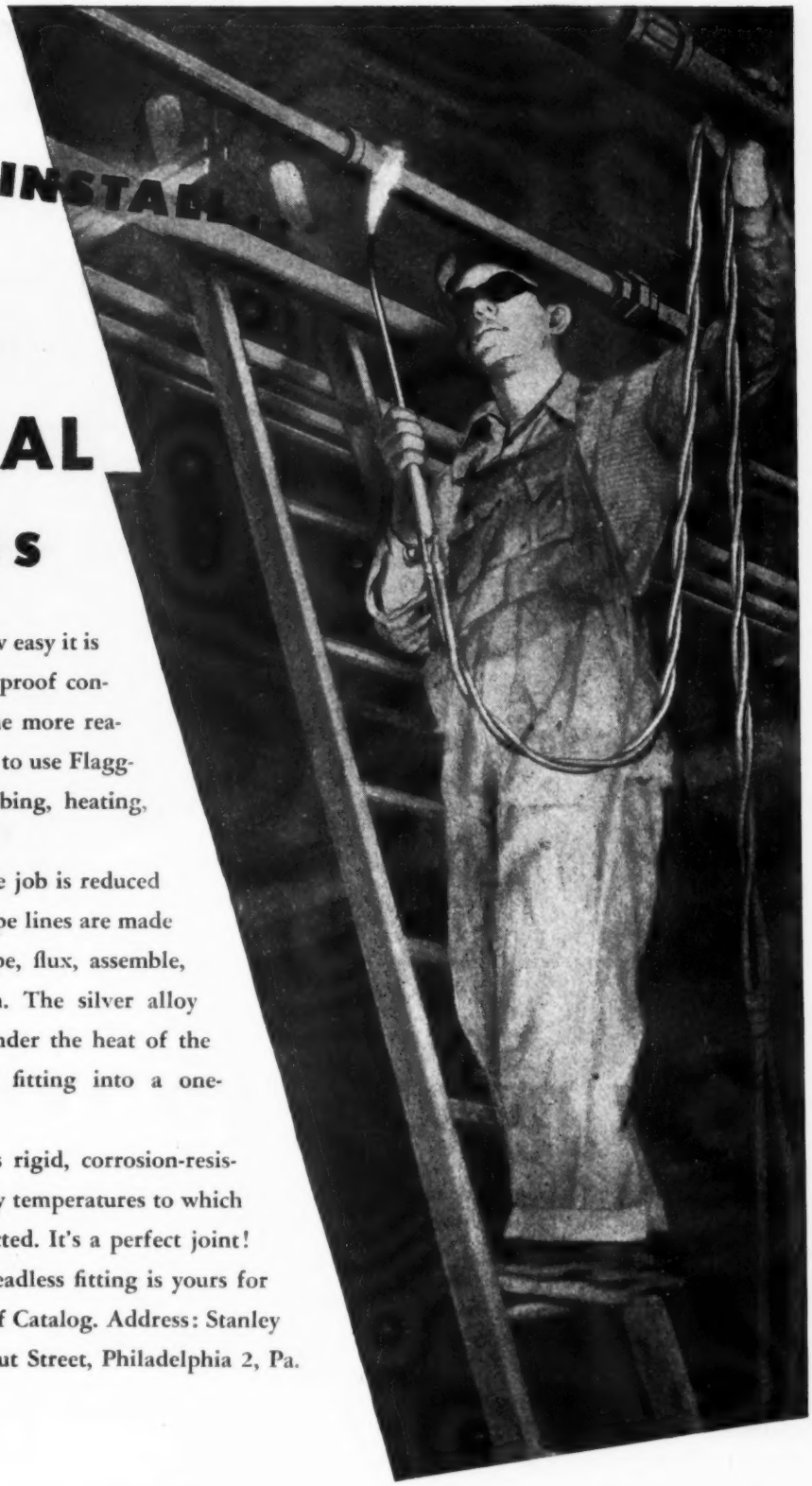
Whether you need special or standard motors, 1/8 to 200 H.P., it will pay to learn why so many critical buyers specify "Star". Some standard motors are ready for early delivery. Star Electric Motors Co., 228 Bloomfield Avenue, Bloomfield, N. J.

Integral HP Motor for Direct Current

STAR MOTORS

POWER PACKAGED AS YOU NEED IT

IT'S EASY TO INSTALL . . .



He's using FLAGGSEAL SILBRAZ JOINT* FITTINGS

The illustration tells the story. See how easy it is for the operator to make permanent leakproof connections, using Flaggseal. This is just one more reason why profit-minded contractors prefer to use Flaggseal fittings for copper and brass plumbing, heating, gas, fuel and process pipe lines.

Moreover, the time required to do the job is reduced to a minimum, when copper and brass pipe lines are made this modern threadless way. Cut the pipe, flux, assemble, then braze with the oxyacetylene torch. The silver alloy insert in the bore of the fitting melts under the heat of the torch, permanently bonding pipe and fitting into a one-piece pipe line.

The finished Flaggseal connection is rigid, corrosion-resistant, vibration-proof, and is unaffected by temperatures to which copper or brass pipe can safely be subjected. It's a perfect joint!

The whole story of this modern, threadless fitting is yours for the asking. Write today for a free copy of Catalog. Address: Stanley G. Flagg & Company, Inc., 1421 Chestnut Street, Philadelphia 2, Pa.

**Patented—Reg. U. S. Pat. Off.*

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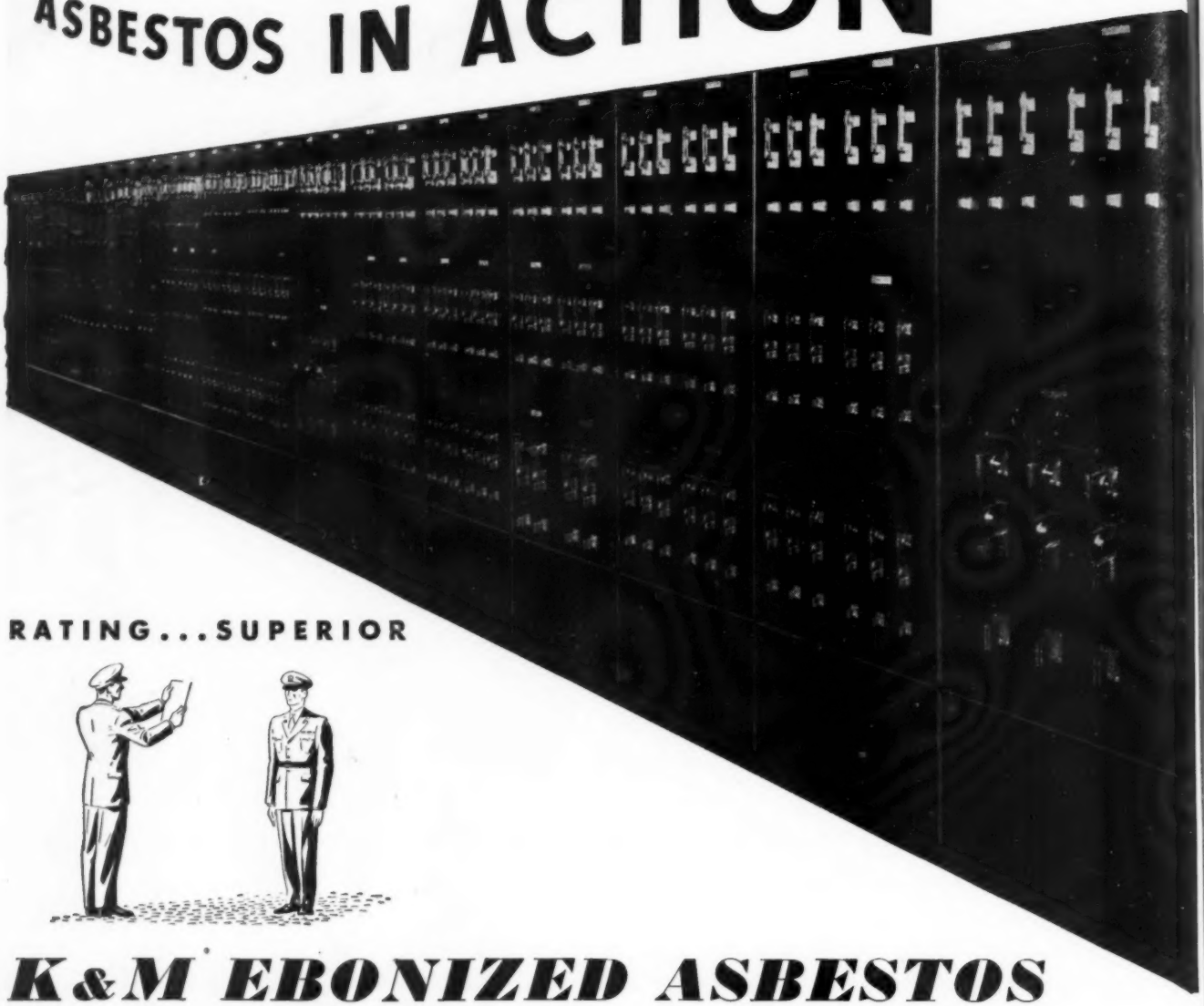
FLAGG FITTINGS

SINCE 1854

MALLEABLE IRON FITTINGS • CAST IRON SCREWED FITTINGS • DRAINAGE FITTINGS
FLANGE UNIONS • FLANGES • GROUND JOINT UNIONS • RED BRONZE FITTINGS
FLAGGSEAL BRONZE FITTINGS • SPECIALTIES AND CASTINGS

ASBESTOS IN ACTION



RATING...SUPERIOR

K&M EBONIZED ASBESTOS

• For unfailing performance in action, in spite of severe shock and vibrations . . . for unusual ability to resist oil and moisture . . . for high dielectric strength, progressive electrical engineers rate K&M Ebonized Asbestos as *superior*.

K&M Ebonized Asbestos mounting material is not affected by rapid changes in temperature, nor will it crack, shrink or bulge. It is made of a combination of asbestos fibre, binding cement and insulating compound, molded under terrific pressure into strong monolithic sheets. It is uniform in density. It comes in standard or special "panel" finish . . . from ⅛" to 4 inches thick.

Not only does K&M Ebonized Asbestos meet exacting requirements for electrical switchboards, but it is also ideal for bus bar runs, testing tables, cabinets, bench boards, compartment linings and many other types of electrical installations.

Ebonized Asbestos is specially developed to meet the technical requirements of Underwriters Laboratories, Inc. when built into an assembled unit. Nature made Asbestos...Keasbey & Mattison has been making it serve mankind since 1873.

Photo
Courtesy Frank Adam Electric Co.
St. Louis, Mo.

KEASBEY & MATTISON

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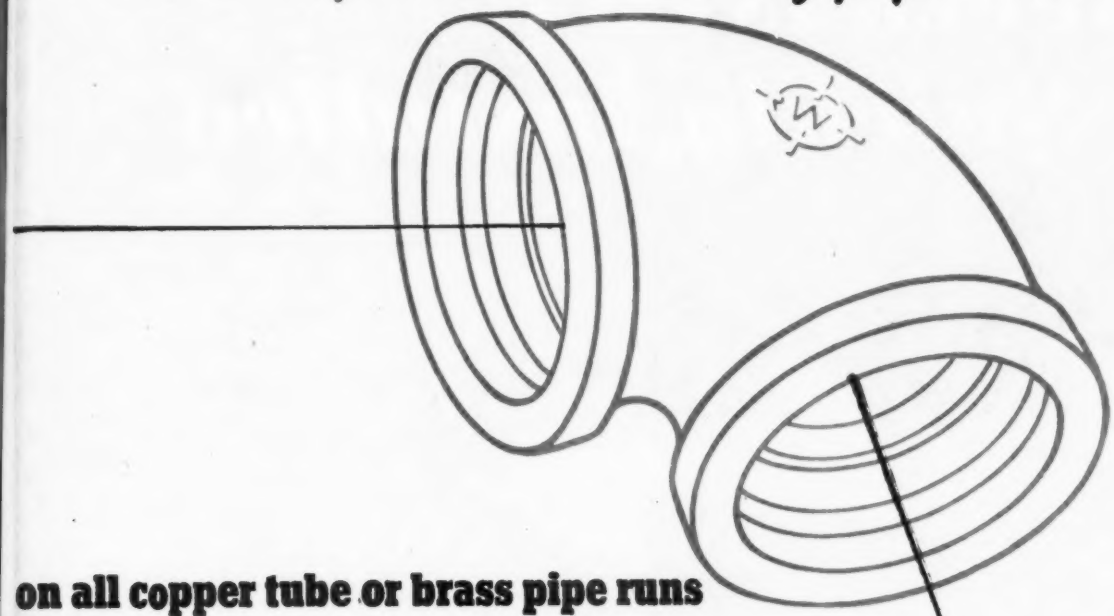
The sure way to cut the cost of pipe maintenance



on all copper tube or brass pipe runs

...SPECIFY THREADLESS

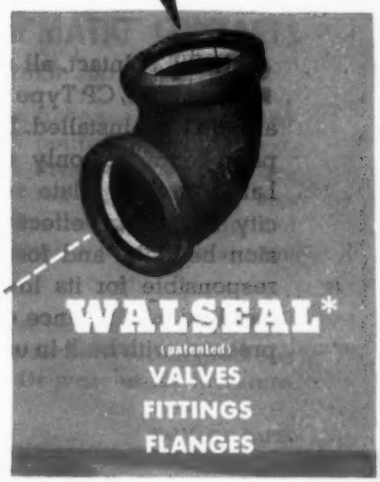
SILBRAZ* JOINTS

Whenever your plans call for copper tube (iron pipe size) or brass pipe — especially in public, industrial or commercial buildings — specify patented threadless Silbraz joints made with Walseal valves, fittings and flanges. Silbraz joints effectively produce strong, lasting pipe runs.

These modern joints provide positive protection against leaks by actually becoming a part of the pipe itself. They make a "one-piece" pipe line that will not creep or pull apart under any pressure, shock or vibration that the pipe itself can withstand.

Easily installed by oxyacetylene torch brazing, Silbraz joints are the sure answer to low-cost assemblies that will require neither maintenance nor repair in the years to come. Ask your nearest Walworth distributor, or write for copy of Circular 84 giving complete data on Walseal Silbraz joints.

*Patented – Reg. U.S. Patent Office



Make it a "one-piece pipe line" with WALSEAL

13 AWARDS TO 4 PLANTS

WALWORTH

valves and fittings

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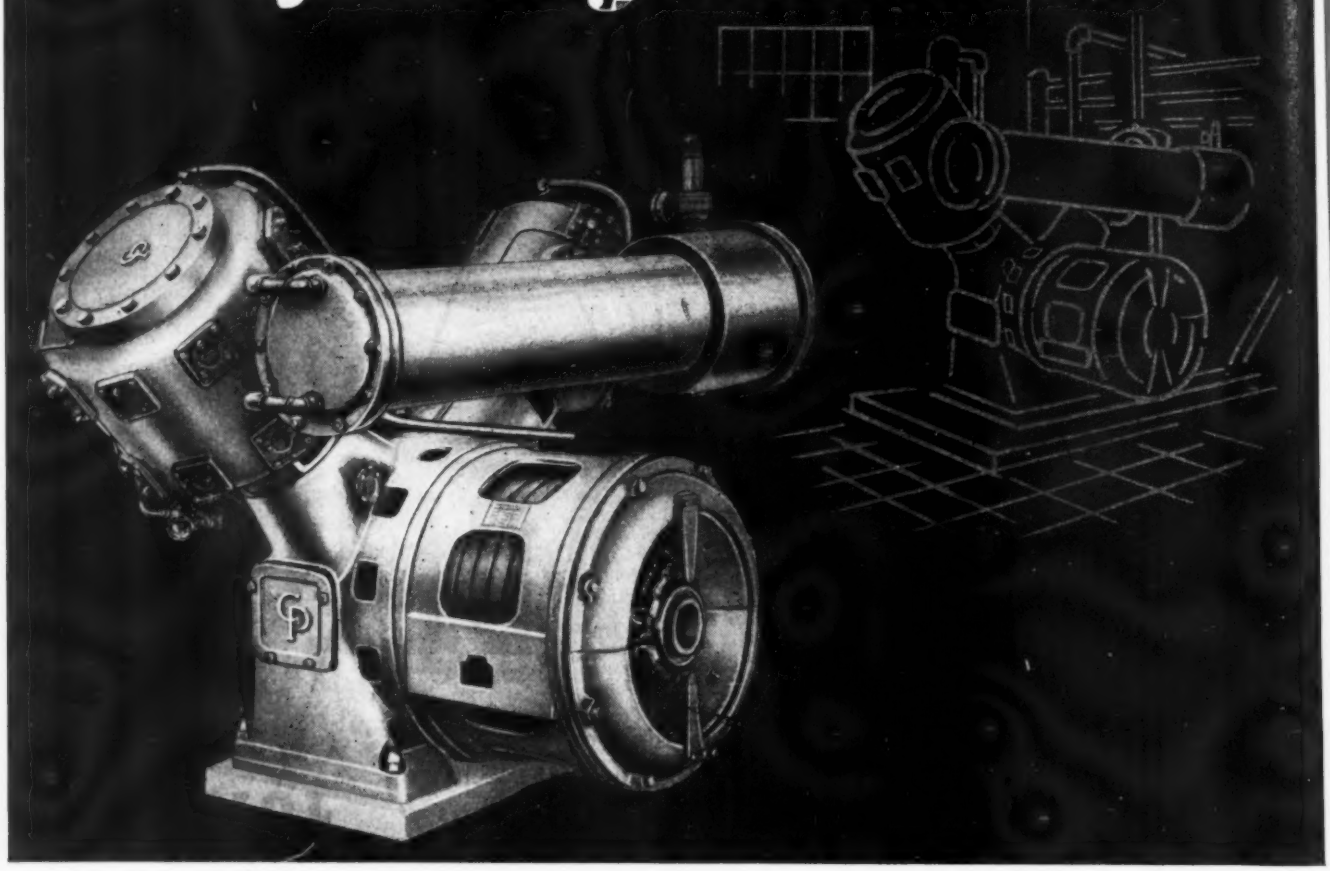

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SHIPPED intact, all ready for external connections, CP Type Y Compressor is easily and quickly installed. It is exceptionally compact, requiring only minimum floor space. Large area Simplate valves, multi-step capacity regulation, effective intercooling, precision bearings and force-feed lubrication are responsible for its low power consumption and low maintenance costs. CP Type Y compressors with built-in or direct coupled motors or with V-belt drive are available in capacities of 500 to 900 c.f.m. at 80 to 125 pounds pressure; other sizes available for higher and lower pressures. Write for Bulletin 766.

There is a CP Compressor, stationary or portable, for every air requirement from 25 to 10,000 c.f.m. for pressures up to 5,000 pounds.

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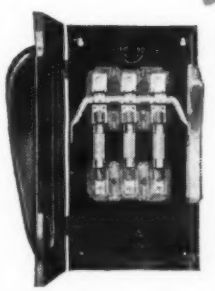
DIESEL ENGINES
AVIATION ACCESSORIES

Legionnaires

Vacu-Break SAFETY SWITCH with "CLAMPMATIC" CONTACTS

Sizes for Every Switch Job



For greater safety and dependability, longer life and lower upkeep costs, leading plants the country over depend on BullDog Vacu-Break Safety Switches.

Designed in a wide variety of sizes and types with capacities ranging from 30 to 1200 amperes, standard models of this famous switch are available for every industrial requirement.

No other safety switch has "Clampmatic" contacts, tight as a bolted connection in the ON position, to reduce heating—the Vacu-Break principle of arc suffocation to snuff out destructive arcs as quickly as they form—new simplified operating mechanism in modern streamlined cabinet.

Talk to expert BullDog field engineers about the electrical distribution problems in your plant. Or write us for literature.

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SALVAGE PAPER

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ELECTRIC PRODUCTS COMPANY

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Also Manufacturers of

SafToFuse Panelboards—Switchboards—Circuit Master Breakers—Universal Trol-E-Duct, for flexible lighting—Industrial Trol-E-Duct, for movable "loads"—BUS-tribution DUCT, for "Plug-In" Power.

FOR a good many years we have talked about how Jones speed reducers, gears and other transmission products have been built for long trouble-free service. Some people might have said that we placed too much emphasis on ruggedness, stamina and the ability of our products to "stand up and take it".

But today in every phase of war work, industry is calling for products that will measure up to these standards by continuously staying on the job.

Our Bulletin No. 80 "Jones Drives for Industry" will give you a complete outline of the range of Jones speed reducers, gears and other transmission products that are built to stand the 24-hour a day drive for victory. We shall be glad to mail you a copy.

W. A. JONES FOUNDRY & MACHINE CO., 4423 Roosevelt Road, Chicago, Illinois

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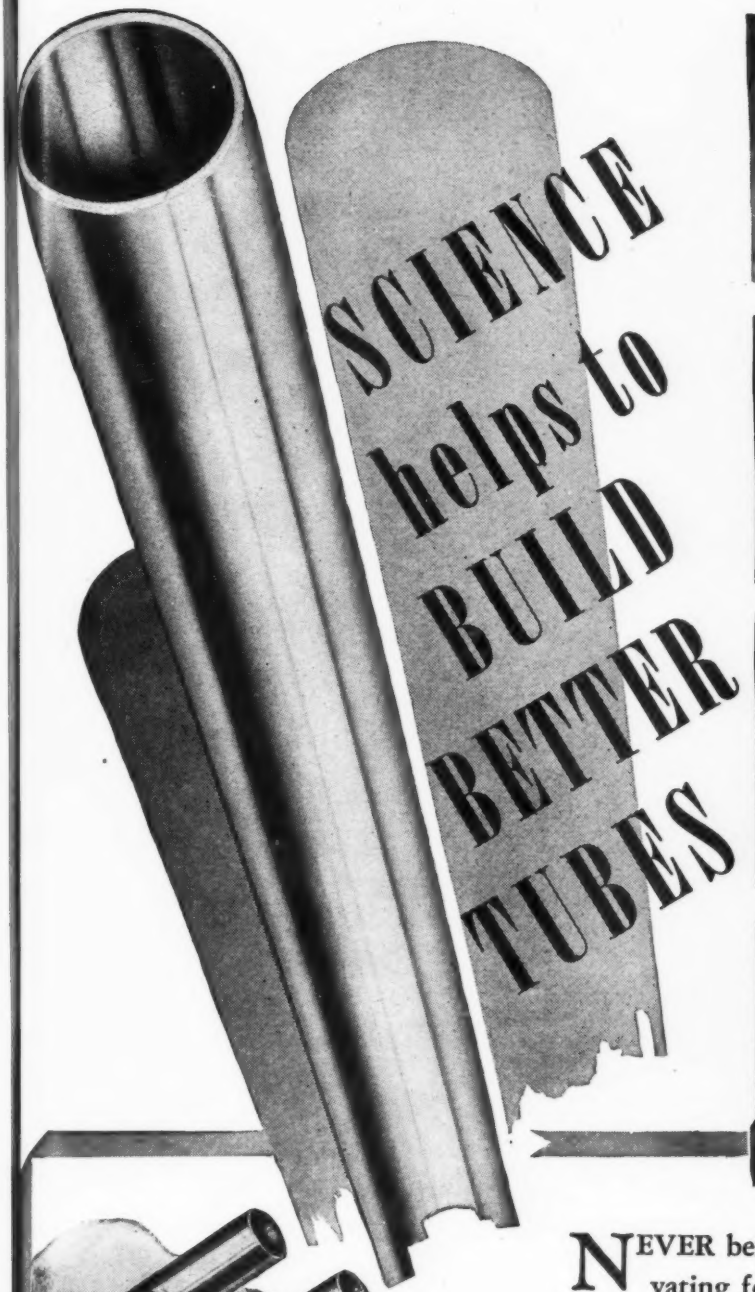
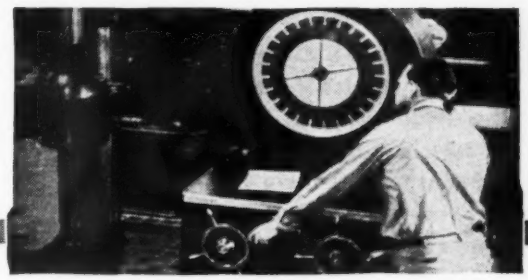
PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES



SCIENCE helps to BUILD BETTER TUBES



GLOBE STEEL TUBES

NEVER being satisfied with the "best" is the motivating force of science. The same spirit prompts Globe to maintain complete chemical and physical laboratories for steel tube research and for production control. The scientific approach explains why uniformity and quality are so accurately controlled at Globe. Whatever the tube requirement, Globe usually has the answer, based on these essential facilities — practical experience, manufacturing skill and specialized knowledge. You can be sure of uniformity and quality when you specify Globe tubes — pressure, mechanical or stainless.

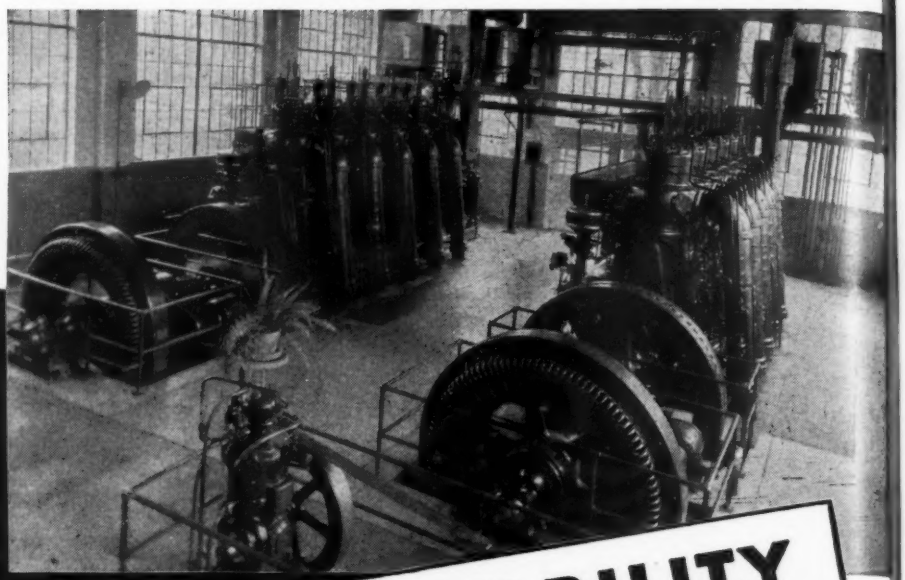
GLOBE STEEL TUBES CO., Milwaukee 4, Wis.

- ★ Pressure Tubes
- ★ Condenser & Heat Exchanger Tubes
- ★ Seamless Stainless Steel Tubes
- ★ Mechanical Tubing
- ★ Gloweld Welded Stainless Steel Tubes
- ★ Globeiron High Purity Iron Seamless Tubes

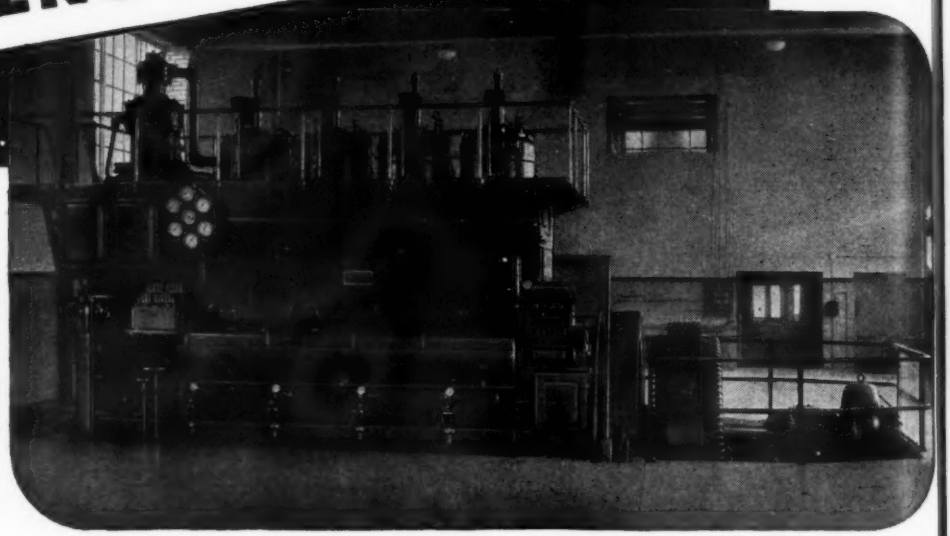
GLOBE TUBES

5022

The first Nordbergs installed in the municipal power plant at Neodesha 1922 were these two units of 550 B.H.P. each.



This is what is meant by NORDBERG DEPENDABILITY



This third engine of 880 B.H.P. was placed in service in 1934. With the addition of a 1620 B. H. P. engine now being built, Neodesha will have an installed capacity of 3600 horsepower in Nordbergs.

Don't say DIESEL— say NORDBERG

● Only once in twenty years has there been an interruption of service at Neodesha, Kansas due to a failure of the Diesel engines and this sole interruption was only of ten minutes duration. The dependability of Nordberg Diesels is being proved by their year in and year out performance in many of America's more prominent Diesel power plants.

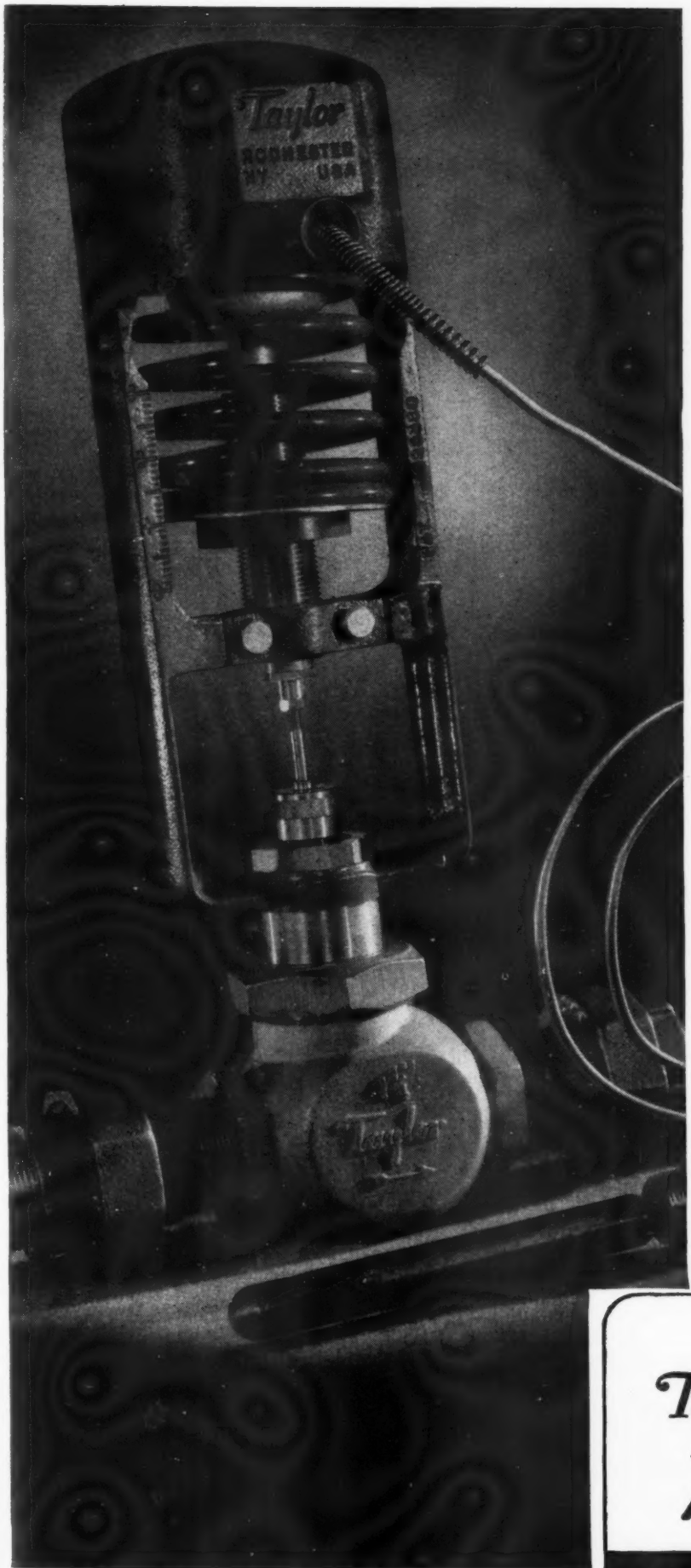
NORDBERG MFG. COMPANY • MILWAUKEE 7, WISCONSIN

NORDBERG MACHINERY

NORDBERG

DIESEL ENGINES

NORDBERG MACHINERY



Maybe the job isn't that tough!

WE hate to argue with a customer. But when we find one ordering a Taylor Fulscope air-operated Controller for a job where a simple, dependable Taylor Self-Acting Controller would be entirely adequate, we feel as though we ought to speak up.

You can spend a lot more money than necessary on fancy controls (and we make them, too) for many jobs where very close control is not required. Typical jobs which the Taylor Self-Acting Temperature Controllers take in stride are: hot water tanks, diesel water jackets, feed water systems, condenser cooler water in stills, oil field superheaters, wax coating machines, plating and rinsing tanks, bottle and can washers, mixing and cooling kettles, etc.

They require no auxiliary air supply for operation. Double seated valves are available in sizes up to 2"; single-seated composition disc types up to 1". Numerous standard temperature ranges within limits of 10° and 340° F, and semi-standard ranges within limits of 165° and 610° F.

Write for catalog 36-R. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*

ARMY NAVY

Taylor Instruments

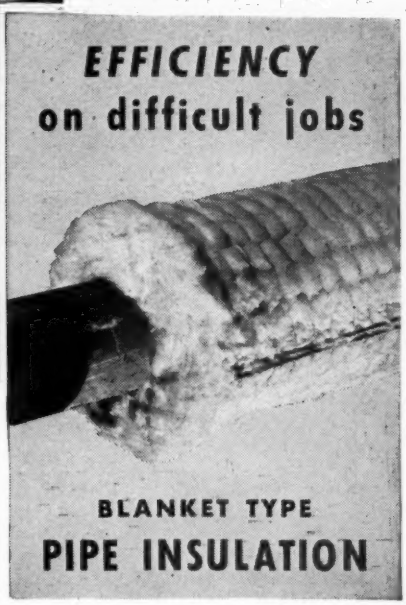
MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

BUY ANOTHER WAR BOND TODAY!

★pipes "tough" to insulate



..another job for

FIBERGLAS*

In co-operation with the Government program to save critical fuel.

Many conditions which present difficulties for other types of insulation are efficiently overcome when Fiberglas Blanket Type Pipe Insulation is used.

It is particularly well adapted for application on riveted or welded pipes and on pipes that do not conform to standard dimensions. It assures a perfect fit over protruding rivets and can be used on any size pipe from 3" to 42" in diameter. This type of Fiberglas insulation is designed for insulating pipes at temperatures up to 1000° F.

Light in weight, Fiberglas Blanket Type Pipe Insulation is easy to handle and apply.

It is made of Fiberglas Insulating Wool, type TW-F, an exceptionally efficient blanket of fine, long, strong, interlaced fibers *requiring facing on one side only!* The wire mesh used to face the outer surface is secured to the Fiberglas by asbestos yarn ties. Available in standard 2 ft. sections. An extra inch of insulating wool at each end assures an intermeshed, heat-tight joint.

A sheet metal selvage is provided at the ends of the blanket. In application the selvages are simply laced together with galvanized wire. On bends the insulation is cut to shape and the selvages are laced together on the outside radius, permitting the mesh on the inside to conform to the contour of the pipe. When properly applied, uniform thickness and density of insulation are assured.

There is a form of Fiberglas insulation to meet every need. Write for your copy of "Fiberglas Insulations for Industry". *Owens-Corning Fiberglas Corp., 2000 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

FIBERGLAS INDUSTRIAL INSULATIONS

1. PF Pipe Insulation—A lightweight, preformed pipe covering with high insulating efficiency for temperatures up to 600° F. Made in 3-ft. sections or segments for all standard pipe sizes. Fibrous ends of sections intermesh to form tight joints.

2. Blanket Type Pipe Insulation—With mesh wire on outer side to wrap around pipe and secure with wire through special edging. Manufactured in 2-ft. sections for pipes over 3" O.D. Will withstand temperatures up to 1000° F.

3. Metal Mesh Blankets—With mesh wire or expanded metal on one or both sides. Lightweight and easily applied. 2 ft. x 4 ft. and 2 ft. x 8 ft. In standard thicknesses. Two types: For temperatures up to 600° F. and 1000° F.

4. No. 600 PF Block—Same materials as in PF Pipe Covering—in blocks 6" x 36" and 12" x 36", standard thicknesses.

5. OC-1800 High Temperature Block—A highly efficient molded block in sizes 3" x 18" and 6" x 36" and 12" x 36"—in standard thicknesses. Will withstand surface temperatures up to 1800° F.

6. Insulating Cement—For insulating fittings, valves and all irregular surfaces. Highly efficient . . . withstands temperatures up to 1200° Fahrenheit.

7. OC Mastic Finish—An asphalt emulsion cement for insulated pipe and equipment exposed to outdoor or high moisture conditions.

8. Insulating Wool, Type TW-F—Available in bats, rolls and bulk. Used for drying-ovens, heaters, etc., for filling irregular spaces.

9. PF Insulation—Manufactured in 5 densities from 2½ to 9 lbs. per cu. ft.—standard sizes 24" x 48", 1" to 4" in thickness, according to density. For insulated panels, sound absorption and various semi-structural applications.

10. PF Roof Deck Insulation—9 lbs. density with facing to facilitate mopping. Highly efficient, with noncombustible, rotproof and moisture-resistant core, for application under industrial built-up roofings. Sizes 24" x 48". Thicknesses from $\frac{1}{2}$" to 2".

FIBERGLAS

*Trade Mark Reg. U. S. Pat. Off.

INDUSTRIAL INSULATIONS

WITH

Brad Foote Gears

RATIOS	
HERRINGBONE	2:1 to 295:1
WORM	3⅝:1 to 60:1
GYRO	16:1 to 30,000:1
SPUR	2:1 to 40:1
VERTICAL HELICAL	2:1 to 80:1
SPIRAL BEVEL	1:1 to 5:1
PLANETARY	4:1 to 400:1
OIL WELL UNITS	12:1
LITTLE GIANT	28:1

Brad Foote precision cut gears are made in our ultra modern plant from any practical material in all practical sizes, (spur gears may be cut in diameters up to 108 inches) in any quantity, large or small.

Trained personnel—extensive shop equipment necessary to do all types of special precision gears—large plant capacity assure the prospective buyer maximum results and production in amounts of any proportion.

ARMY E NAVY

BRAD FOOTE GEAR WORKS

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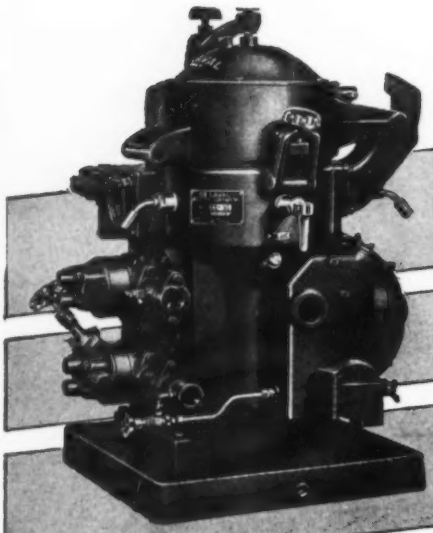
Dept. U. Cicero, 50, Ill.



HALF PROTECTION FOR A POWER UNIT IS NOT ENOUGH!

TURBINES AND DIESEL ENGINES **require protection from two different causes of lubrication failure—*water* and *dirt*. Removal of dirt alone merely does half a job. *DE LAVAL* Oil Purifiers provide *complete* protection. Why?**

***BECAUSE*-** De Laval Oil Purifiers continuously remove and discharge water while removing the dirt as well. And water is the real trouble-maker as often as not . . . in turbine lubricating systems, for instance, condensate water in the oil leads to the formation of sludge, and sludge, of course, is well recognized as the real trouble-maker in turbine lubrication systems.

Diesel oils, too, should be kept dry if the formation of emulsions is to be avoided. Today's new, heavy types of Diesel lubricating oil make this phase of De Laval purification by centrifugal force of more than ordinary importance.

Centrifugal force applied in the De Laval bowl gives equally positive protection against dirt . . . keeps the oil clean and in "like-new" condition.

In short, De Laval Oil Purifiers afford turbines and Diesel engines ***full protection*** against the principal causes of lubrication failure, by removing the impurities that contaminate oil in service.

ADVANTAGES OF DE LAVAL LUBRICATING OIL PURIFIERS

Constant high purifying efficiency—without renewal of functional parts

•

Economical to operate

•

Remove both enemies of good lubricating oil performance: water and dirt

•

Provide maximum protection to power units

•

Give long, trouble-free service

•

Lower maintenance costs

•

Maintain oil in condition most nearly identical with that of new oil

•

Self-draining purifier bowl makes for easy cleaning

DE LAVAL

LUBRICATING OIL PURIFIERS

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

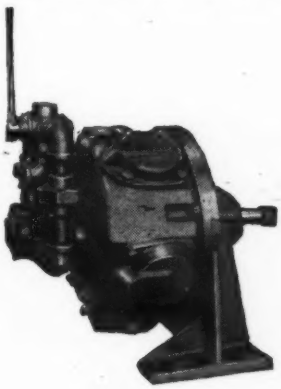
NO "RAPIDS" TO HINDER THIS FLOW!

Rapids . . . rocks and obstructions in a stream . . . cause rough water and dangerous, destructive currents.

In a pump, rough castings, with improperly proportioned passages, have the same effect. Sudden velocity changes and eddies, even though slight, materially affect the life and performance of the pump.

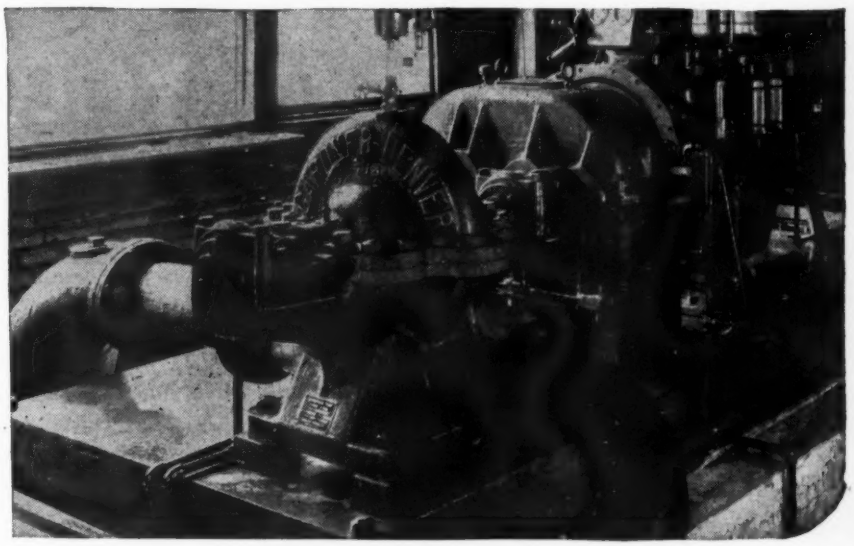
There are no rapids in Gardner-Denver Centrifugal Pumps. Smooth castings assured by rigidly controlled foundry practices and correctly designed water passages result in a free-flow of water—a smooth, uniform flow that means long life and economical pumping performance.

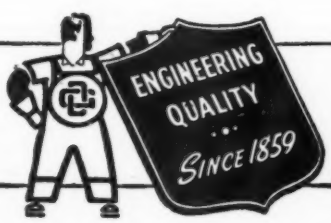
Gardner-Denver CENTRIFUGAL PUMPS are made in a wide variety of types, sizes and capacities for practically every type of pumping service. For complete information, write for descriptive bulletin.



AIR MOTORS

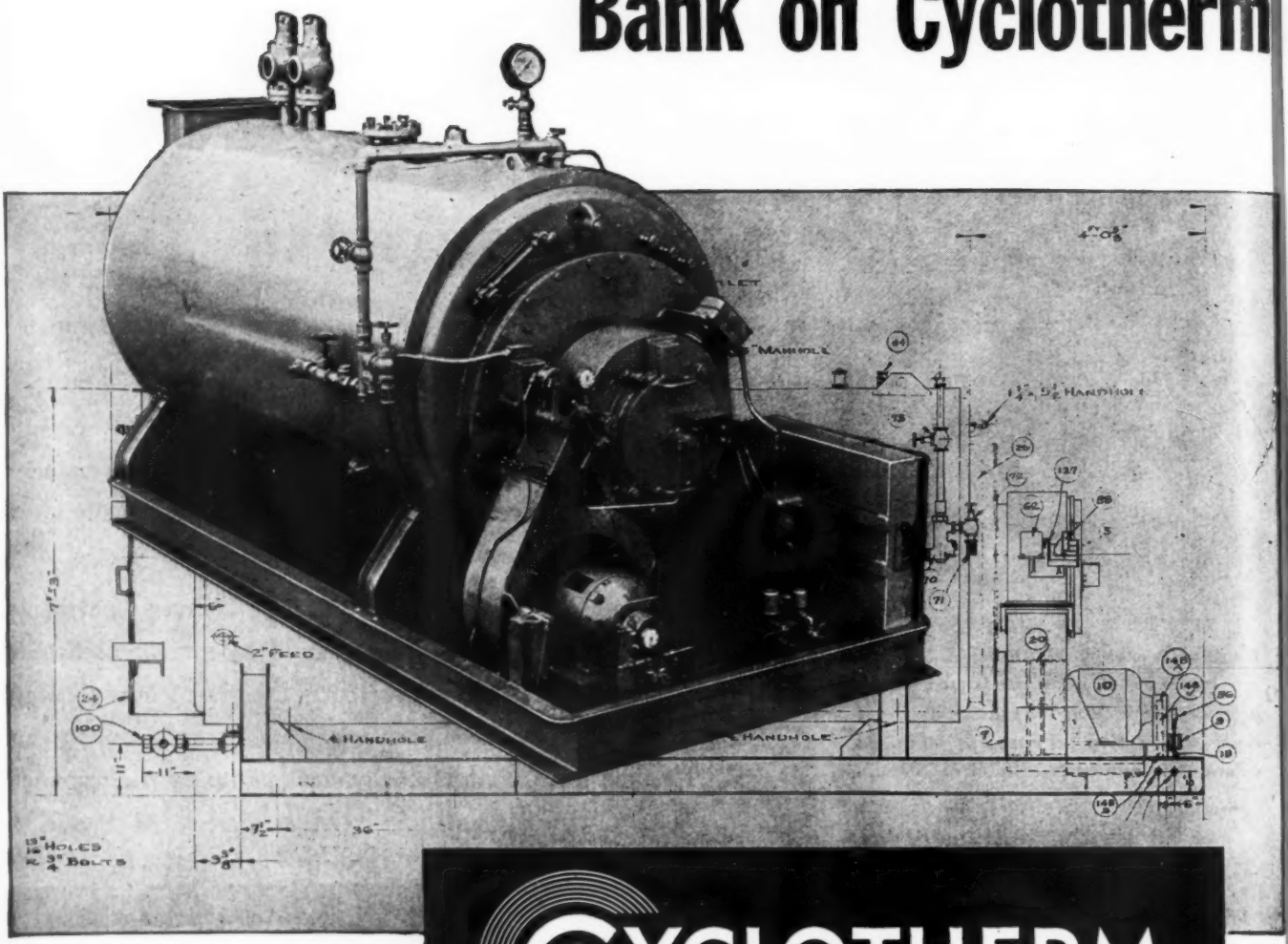
Gardner-Denver Air Motors are five cylinder radial types used to power other equipment where electric or gas motor drives are impractical. Gardner-Denver Company, Quincy, Illinois.





GARDNER-DENVER

When the Pressure is on You Can Bank on Cyclotherm



CYCLOTHERM
STEAM GENERATOR

Cyclotherm Steam Generators are emerging from the war with veteran reputations for delivering results under all kinds of service conditions. Thousands of Cyclotherm units have been in service throughout the world with the Army, Navy and Marine Corps.

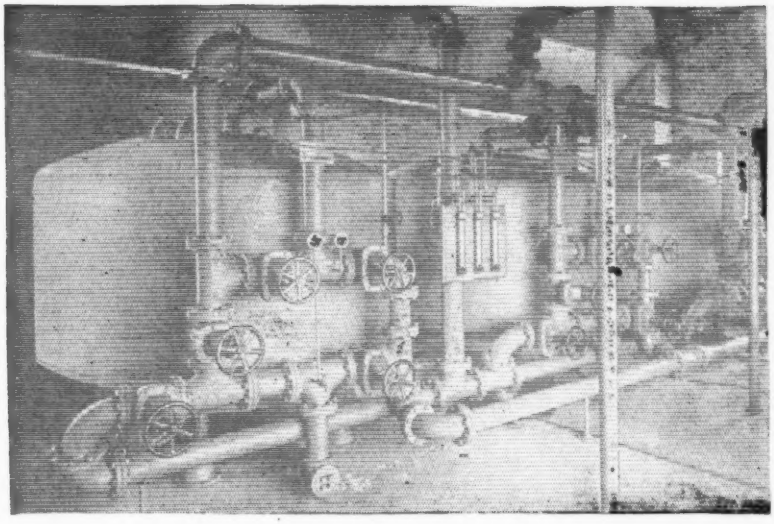
Whether you utilize steam for power, processing or heating there's no job too tough for Cyclotherm. Its record of service is your best guarantee of its builders' engineering "know-how" and the quality built into a Cyclotherm unit.

Cyclotherm units range from 10 HP to 200 HP. They are completely self-contained, automatic, oil or gas fired. They are designed on unique principles of combustion that give top efficiency and service while holding operating and maintenance costs to a minimum.

Cyclotherm comes to you assembled and tested, ready for immediate operation after oil, water, electrical and steam outlets are connected. No special foundation or stack is needed. This packaged steam generator will give you years of continuous, trouble-free, economical service.

Orders are now accepted for early delivery.

CYCLOTHERM CORPORATION • 90 BROAD STREET, NEW YORK 4, N. Y.



LITTLE DROPS OF WATER — LITTLE GRAINS OF . . . ?

No matter how clear and sparkling it may look, there are hidden ingredients in every drop of water you see. Maybe a few grains of hardness . . . or microscopic sediment . . . or a disagreeable taste or odor. Usually it's a combination of these.

For efficient and economical municipal or industrial use these elements must be removed or neutralized. And that's where Graver comes in.

It's been our business for more than thirty years to design, build, and install all types of water conditioning equipment for municipal and industrial use. Our service is complete, starting with a careful laboratory analysis of the raw water and ending with a satisfactorily operating unit. It's a science with us, and results, as shown in installations large and small all over the country, prove that we know our business.

Unless you are absolutely certain that the boiler feed water or process water you are now using is so conditioned as to insure maximum efficiency and economy, you'll find it worth while to consult Graver. We'll be glad to discuss your problems with you and submit unbiased recommendations.

There's a Graver representative as near as your telephone

GRAVER

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Process Equipment Division of

GRAVER TANK & MFG. CO., INC.

4809-25 Tod Ave., East Chicago, Indiana

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Hot Process Water Softeners • Zeolite Water Softeners
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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Influence of Temperature on Corrosion Rate & Water Composition

Heat accelerates practically all the reactions involved in the mechanism of corrosion. Chemical activity is increased by raising the temperature and diminished by lowering it. For example, it may be roughly stated that a temperature rise of approximately 20°C. (36°F.) will double the rate of corrosion. While the effect of temperature is not always so great, frequently it is even more pronounced.

The effect of temperature on corrosion rate generally depends on the nature of the corroding medium. Figure 1 shows the relationship in the case of brass in a 3% sodium chloride solution.

Many power plant engineers keep a careful record of incoming and outgoing cooling waters and incoming steam temperatures in condenser installations because they realize that a unit operating at too high a temperature may fail prematurely. Increased temperature may be the principal reason for unsatisfactory tube life.

The higher temperatures of cooling waters during the summer is one of the factors contributing to more rapid corrosion during that season. Instances have been reported where new condenser tubes installed during the winter season have given longer service than tubes installed during the summer. This difference in performance occurs because the type of protective film which forms on metal in cold water is generally thinner and more continuous than one which forms in warm water. Warm water substantially increases the susceptibility to pitting. As a result of pitting, the useful life of a condenser tube may be considerably shorter than that indicated by the overall corrosion rate. Therefore, when operating conditions involve circulating water of higher than average temperature it is of the greatest importance to choose the right condenser tube alloy. Realizing this, engineers are now specifying more corrosion resisting alloys such as Bridgeport's Duronze IV (aluminum bronze) for a combination of severe corrosion conditions. For example, this alloy should stand up well in power plants situated in the harbors of southern ports or tropical countries where higher temperatures are added to the problems of pollution by sewage, acid wastes and other contaminants. Ordinary alloys fail prematurely under such conditions. Duronze IV and cuzinal (aluminum brass) stand up exceptionally well under such conditions. Every precaution should be taken to prevent air inclusion and reduce turbulence

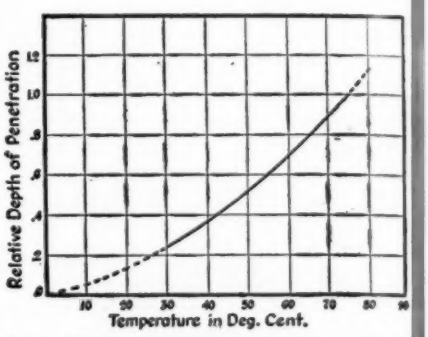

Fig. 1—Effect of Temperature Only on Rate of Corrosion.

since the formation of gases resulting from increased bacterial activities due to higher temperatures accelerates impingement corrosion resulting from these factors.

Temperature May Affect Water Composition

Figure 2 shows the variation in temperatures and the rate of corrosion in an estuary plotted against the seasons of the year. It is evident that as the temperature rises and falls, the corrosion rate also rises and falls with this difference that, when bacterial activity is high there is an increase in the gas content of the water—such as CH_4, NH_3, CO_2 and H_2S. The CO_2 and H_2S are formed in sufficient quantity to have a marked corrosive action.

The presence of gases such as H_2S may destroy the protective film which has been built up during the cool months when the water composition is more nearly normal.

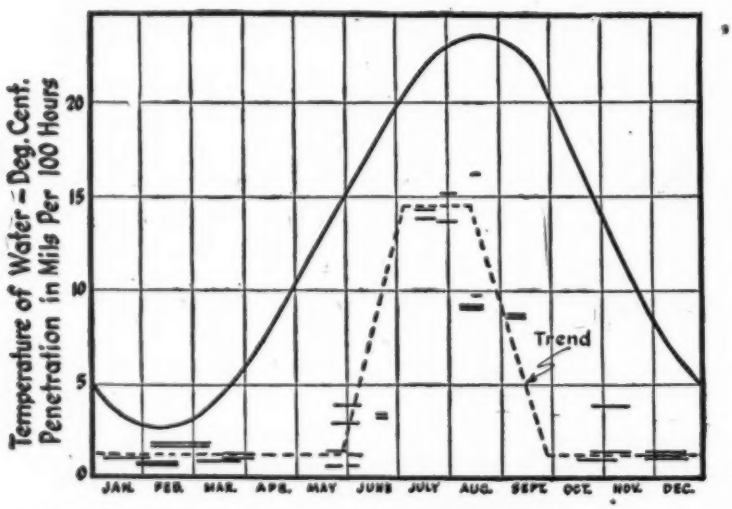

Fig. 2—Effect of Temperature and Bacterial Activity on Rate of Corrosion in Impingement Corrosion Test—Smooth curve records mean water temperature. Short horizontal lines represent results of individual tests, both magnitude and duration. Dotted lines indicate approximate trend of results.

Selection of Proper Condenser Tube Alloy Pays Big Dividends

In recent years power plant and marine engineers have been paying more attention to the character and properties of the condenser and heat exchanger tubing which they have been using. Greater overall economy in the long run is brought about by the use of the best available alloy regardless of cost. The saving from reduced maintenance, increased efficiency from cleaner tubes and the reductions in shut-downs and interrupted service, soon more than pay for the difference between the best available alloy and ordinary materials. Considerable data on corrosion, water composition, modern condenser tube alloys together with methods of installing and removing condenser tubing, is published in Bridgeport's 112-page Condenser Tube Manual which is available for the asking. Write for your copy today.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

BRASS

ESTABLISHED 1865

CAN YOU ANSWER THESE 3 QUESTIONS?

1. **How efficiently do your boilers or furnaces burn fuel?**
2. **How accurately can your operators contral fuel combustion?**
3. **What have wartime overload conditions done to your fuel consumption?**

**(Available only in Cities Service Marketing Territories East of the Rockies).*

If you can't answer these questions, you can find your answers—in just a few minutes—with the Cities Service Industrial Heat Prover.

This unique instrument, exclusive with Cities Service, registers quickly and continuously the per cent of oxygen and combustibles present in the escaping gases or in the furnace atmosphere. Shows you how to burn fuel efficiently and economically.

Invaluable for checking furnace atmospheres in the heat treatment of metals.

This instrument represents just another contribution by Cities Service to wartime conservation of critical material.

Take advantage of the free demonstration offer on your own equipment...at no obligation.*

Mail this coupon today for further information

Cities Service Oil Co.
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Gentlemen: Please send me further information on your free demonstration offer of the Cities Service Industrial Heat Prover—at no obligation to me.

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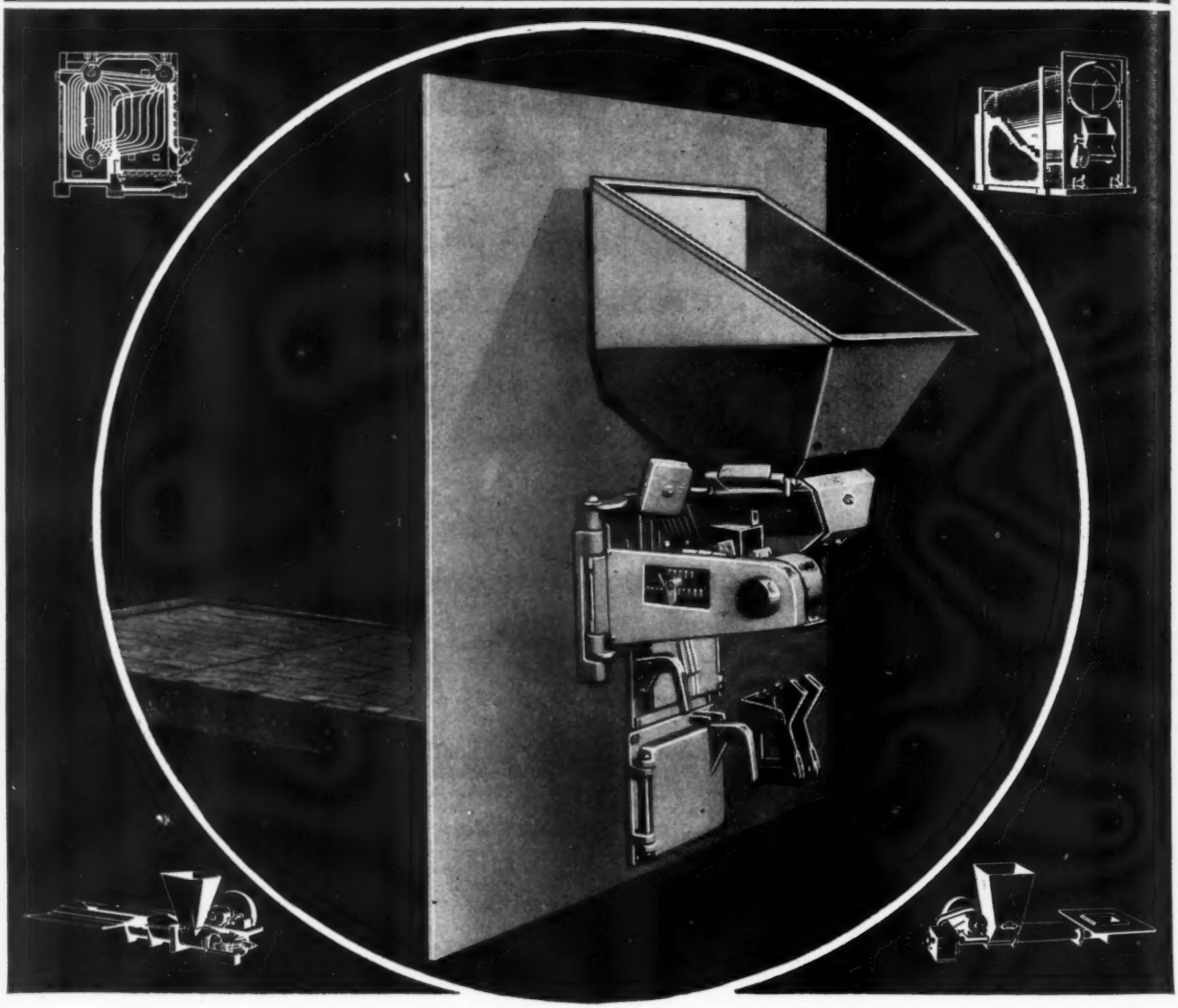
SAVE FUEL, TIME AND LABOR



...by using BROS SUPER-SPRED STOKER

YOU can be sure of lower fuel bills with the Bros Model 16 Super-Spred Stoker. It makes possible the use of the most economical coals obtainable. It maintains high efficiencies under widely fluctuating, but consistently heavy loads, because full floating control proportions the fire to the boiler load at all times.

Large hopper capacity means longer intervals between refuelings, thus saves time and labor.

The stoker feeds from the hopper to an overrunning rotor which literally "slaps" the coal into the furnace, spreading it evenly over the entire grate. The efficient cooling of the Tuyere type Hulson grates, exclusive with the Bros Super Spred Stoker and the fact that all moving parts run in oil, assure lowest maintenance costs.

Bros Boiler & Manufacturing Company, 1057 10th Avenue S. E., Minneapolis 14, Minnesota.

BROS

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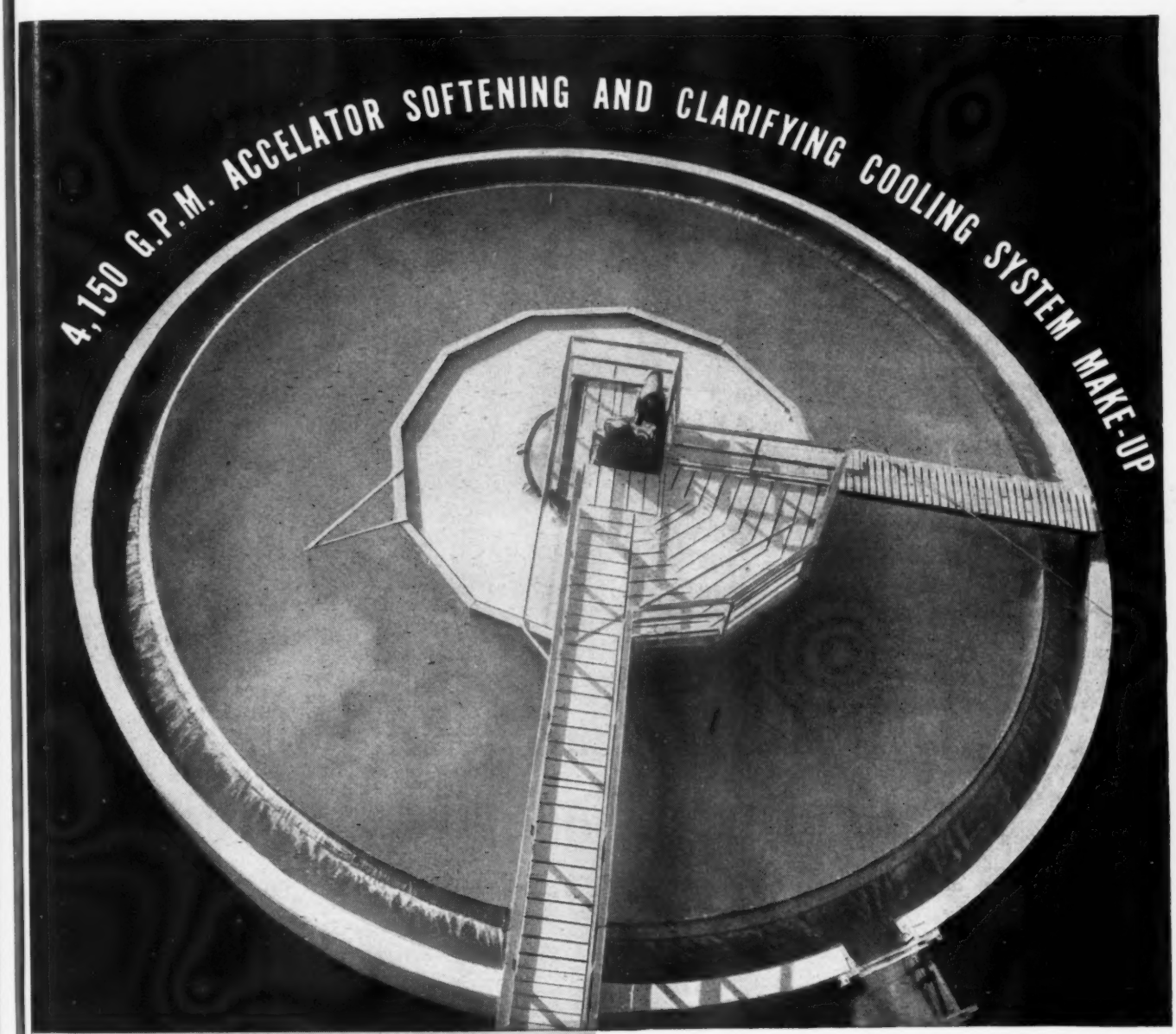

ACCELATORS

ACCELATORS are doing a lot of different things to a lot of different kinds of water . . . clarifying . . . softening . . . stabilizing . . . removing color . . . taking out iron, etc.

Results are always excellent . . . frequently remarkable.

You can't beat ACCELATORS for Performance and Economy. Would you like Bulletin 1824?

INFILCO

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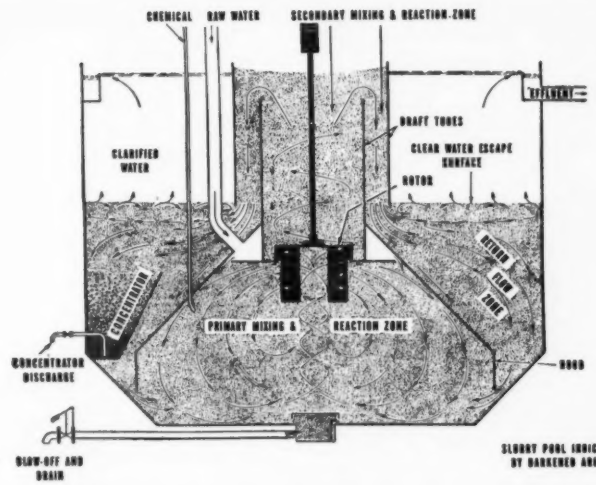
INCORPORATED
325 W. 25TH PLACE, CHICAGO 16, ILL.



Diagrammatic Cross Section Showing Accelator Operation

All treatment steps are combined and carried out quickly in an incredibly small space. Slurry containing previously precipitated solids is recirculated through mixing and reaction and return flow zones. Chemicals are added and raw water mixed in. The sludge contact (maintained by the mechanical recirculation regardless of water throughput) insures rapid and complete chemical reactions—and the treated water rises—not through the sludge—but from the surface of the slurry pool.

RA-TROL
REGULATES CAPACITY with EXTREME ACCURACY
WHAT RA-TROL DOES
RA-TROL regulates the volume of air delivered by a centrifugal fan or blower — with the fan or blower operating at constant speed.
WHERE RA-TROL SAVES
As compared to variable speed control, RA-TROL saves the difference between an expensive variable speed motor and a low cost constant speed motor.
WHEN TO USE RA-TROL
RA-TROL has many applications . . . in ventilating and air conditioning, in mechanical draft . . . use it wherever it is necessary to periodically change the volume of air delivered.

CLARAGE Research Announces an Improved Capacity Control

The dream of fan engineers for a generation has been to perfect a control device which will regulate fan delivery ACCURATELY over a WIDE performance range.

In RA-TROL we have such a device. It is located in the fan inlet as shown above, and can be manually or automatically operated.

RA-TROL closely approaches "straight line" regulation. "Open up" RA-TROL and you get practically a corresponding increase in air volume; "close off" RA-TROL and the volume drops practically in direct proportion.

In contrast to damper control, RA-TROL is much more accurate. In contrast to variable speed control, RA-TROL offers close regulation all the way from 100% fan delivery down to a volume so small as to be well below where fan operation is practical.

Nor is that all! Different than other control devices, RA-TROL permits the fan to operate QUIETLY regardless of the volume of air being handled.

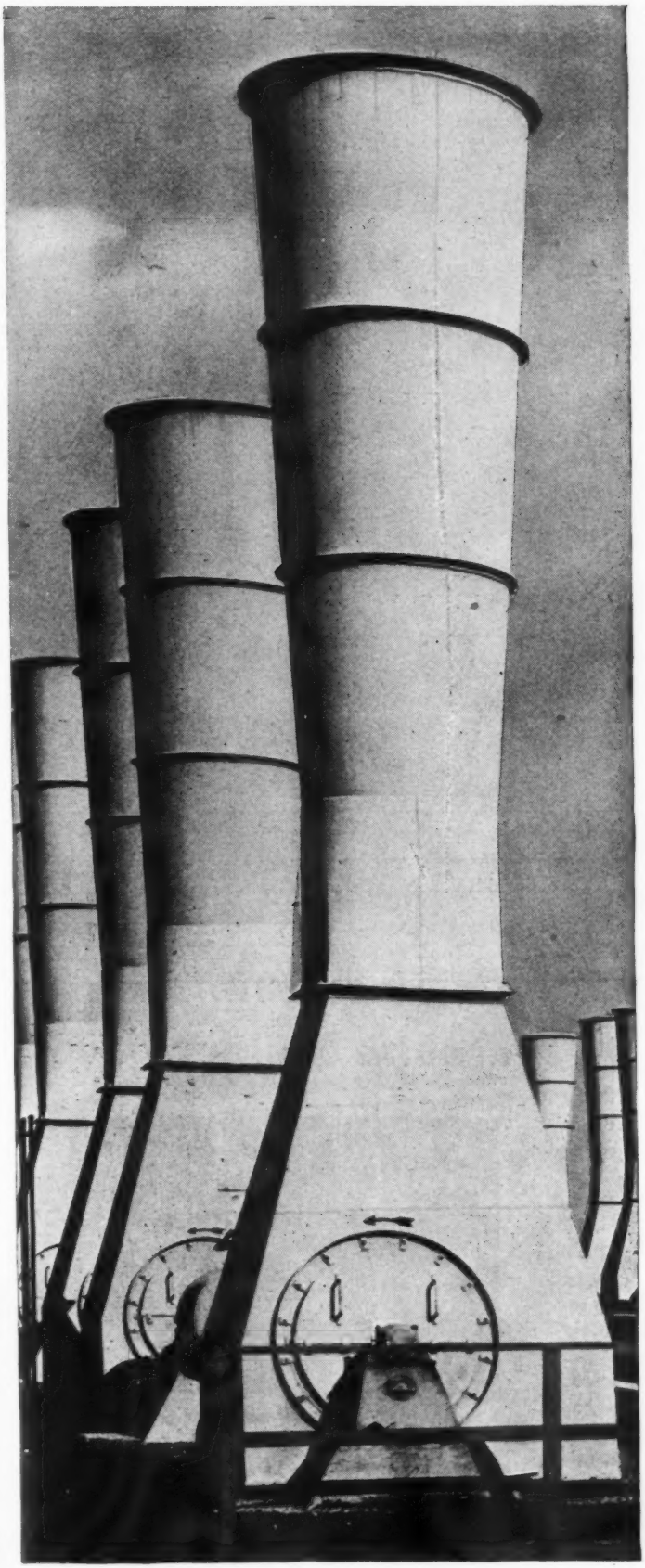
If you require fan capacity control for any service, Clarage fans plus RA-TROL will result in far more satisfactory installations — and you will save money besides. Call in the Clarage sales engineer in your city, or write us at Kalamazoo.

ARMY E NAVY

COMPLETE AIR CONDITIONING • COOLING • VENTILATION • MECHANICAL DRAFT • HEATING • FANS FOR INDUSTRIAL NEEDS

CLARAGE
FAN COMPANY
Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES



DIRECT EXACT SIMPLE

INLET BOXES + I. D. FAN + BREECHING + SELF-SUPPORTING STACK

built, tested, installed as a unit

= THERMIX STACK

DIRECT . . . because the path of flow is an almost straight line from the bottom inlet to top discharge through a highly efficient I. D. fan.

EXACT . . . No longer is it necessary to estimate draft losses due to breechings, bends, inlet boxes, nor the effect of natural draft. No safety factor for these causes is required. You call for and get the exact draft desired for the boiler.

SIMPLE . . . since it is usually installed at the boiler outlet, reducing breeching, design and purchasing costs.

THERMIX ENGINEERING COMPANY

Project and sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

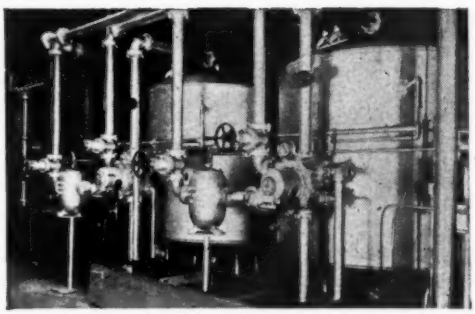
Permutit keeps boilers *clean* — by treating the feedwater before it enters the boilers

In today's heavily burdened power plant, it's easier than ever for impurities in feedwater to cause trouble: scaling and corrosion of boilers and steamlines, slowdowns—possibly even shutdowns.

You can wipe your hands of these troubles with Permutit* conditioned water. Permutit *removes* the impurities in feedwater *before it enters the boilers.*

Manufacturers of water conditioning equipment for over 30 years, Permutit provides *every* process for control of water quality. This includes the Zeo-Karb Water Conditioner (illustrated), Hot and Cold Lime Soda Softeners, Deaerating Heaters, Continuous Blowoff and Demineralizers that deliver a low-cost substitute for evaporated water.

Let Permutit help you prevent boiler scale and corrosion in your steam plant. Write to The Permutit Company, Dept A , 330 West 42nd Street, New York 18, N. Y. or Permutit Co. of Canada, Ltd., Montreal.



PERMUTIT ZEO-KARB* H WATER CONDITIONER removes both hardness and bicarbonates from water. Effluent contains no incrustants, is reduced in total solids and alkalinity. Alkalinity can be adjusted by mixing effluents from a Zeo-Karb H unit and a sodium zeolite unit.

*Trademarks Reg. U. S. Pat. Off.

PERMUTIT

Manufacturers of ALL types of water treatment equipment

Serving industry and the armed forces . . . with GOOD WATER!

WATER CONDITIONING HEADQUARTERS

Chalk Talk No. 6

ON POSTWAR STEAM TRAP ECONOMY

● Another economy of Anderson Super-Silvertops is maximum heat from your unit heaters. These Super-Silvertops increase the delivered heat by keeping the *entire* heater coil drained dry and free of entrained air every minute the unit is turned on. By actual test, a unit heater delivered air at 33% higher temperatures when a Super-Silvertop Steam Trap replaced a temperature actuated trap previously installed. This extra heat was obtained by eliminating the time lag of waiting for hot condensate to cool off before discharge.

Increase your unit heater delivery—get maximum heat—install Anderson Super-Silvertops on every unit heater. Full details on sizing in the book, "How to Choose a Steam Trap," a copy is yours for the asking—no charge.

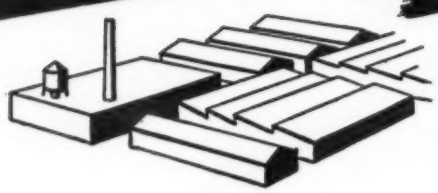
THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS

This Complete Pumping Unit

Pump illustrated is single-stage, split-case centrifugal.

Is Built!



Is Guaranteed!

Is Serviced!

By FAIRBANKS-MORSE

Here's what that means to you. **In addition to sustained high efficiency pumping equipment—with its operation designed to do your particular job—you get three major advantages from Fairbanks-Morse Complete Pumping Units.**

1. **Combined Responsibility.** Designed and built in one factory, pump and driver (motor or engine) are perfectly matched and covered by a single guarantee.
2. **Successful UNIT Performance.** Tested in one plant under expert engineering supervision, pumps and drivers assure you superior operation.
3. **Service from ONE Source.** One engineer is familiar with the entire installation—no question as to who makes any adjustments or repairs.

You get these major advantages from Fairbanks-Morse . . . because only Fairbanks-Morse designs and builds all components of an outstanding line of complete pumping units.

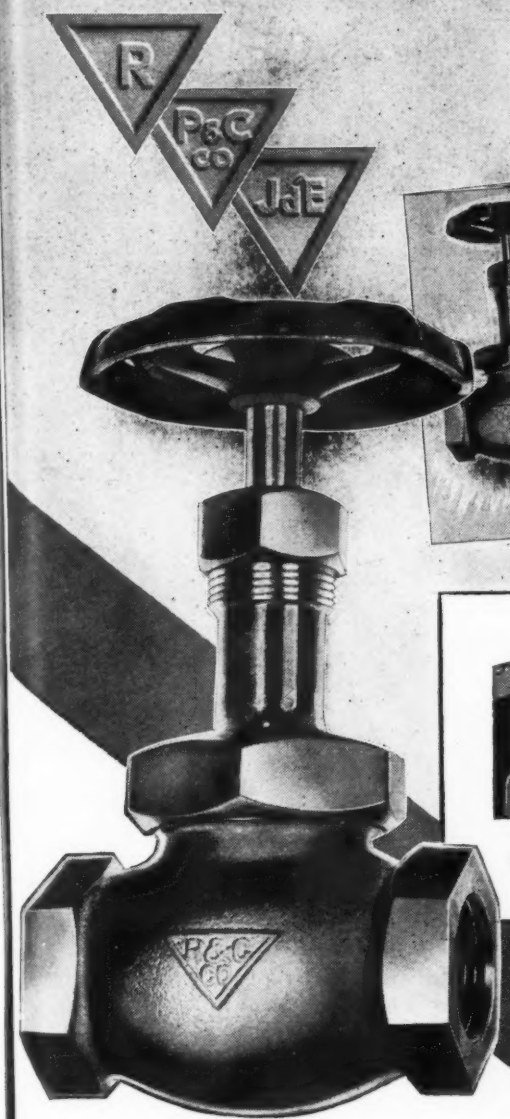
To see a qualified engineer about any pumping job, write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Fairbanks-Morse

A name worth FM *remembering*

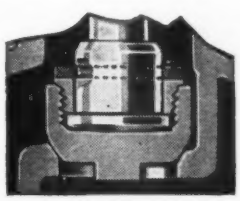
Diesel Locomotives • Diesel Engines
Scales • Motors • Pumps • Generators
Magnetos • Stokers • Railroad Motor
Cars and Standpipes • Farm Equipment

WHERE *Higher* QUALITY MEANS *Lower* ULTIMATE COST

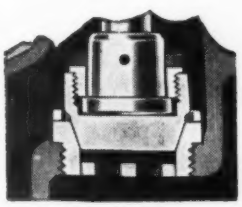


● It's a matter of simple arithmetic. If one valve costs two-thirds more than another and lasts eight times as long in the same service—naturally it's a better buy. That is the principle on which this line of superlative bronze valves is engineered.

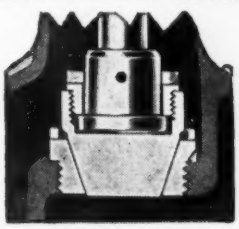
We suggest you send for this file-size folder of information about PRATT & CADY bronze globe and angle valves. The page on "Dollars and Sense of Valve Service" is worthwhile reading for anyone responsible for buying valves. Send for your copy of DH 1285.



Re-Grinding Type
for occasional throttling service



Semi-Plug Type
for frequent throttling service



Full-Plug Type
for severe throttling service

READING-PRATT & CADY

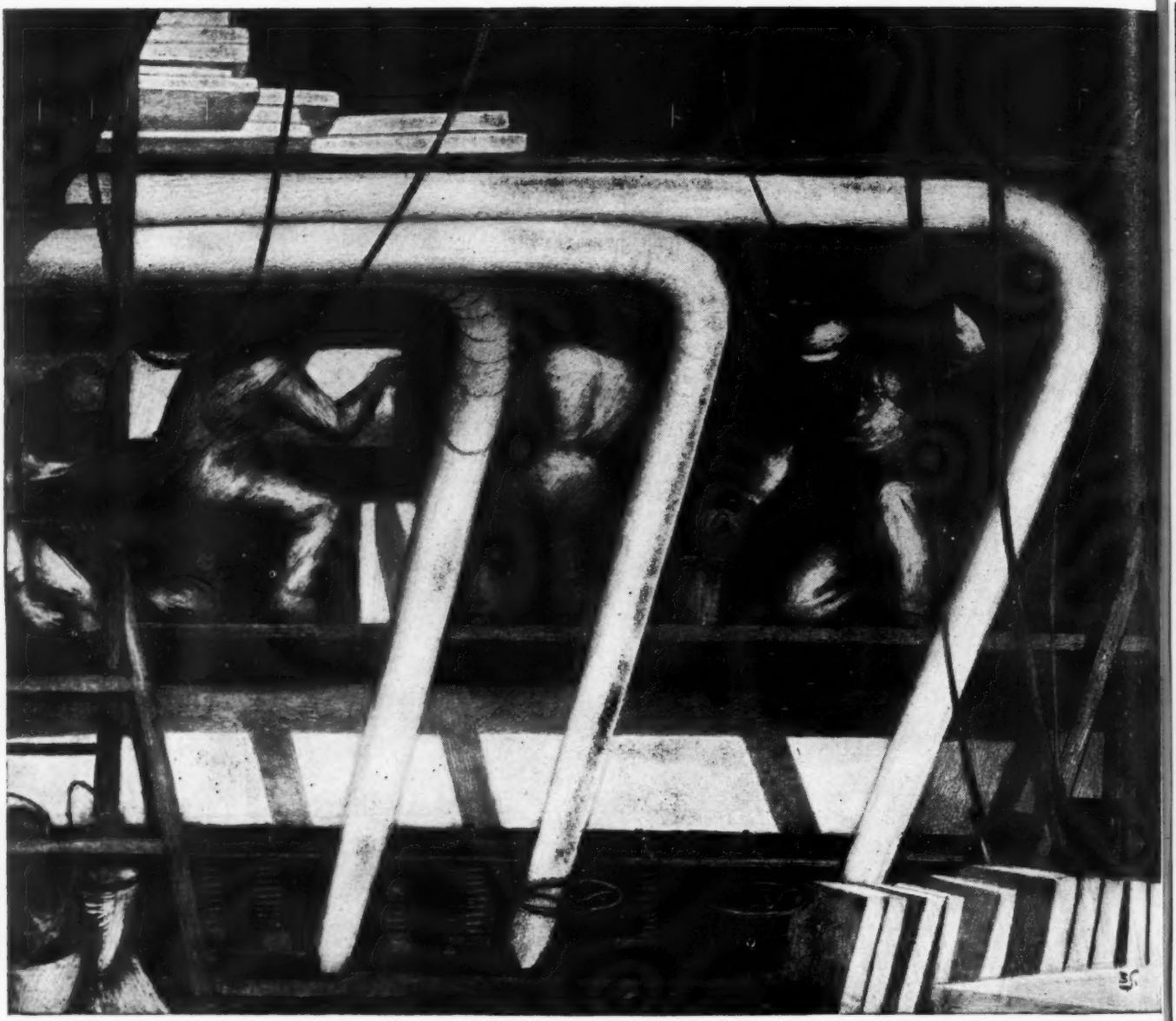
MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE AUTOMATIC REGULATING VALVES

Reading, Pa. • Atlanta • Boston • Chicago • Denver • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

ACCO

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

In Business for Your Safety

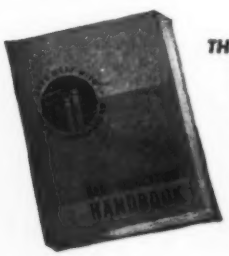


ORIGINAL LITHOGRAPH BY BENTON SPRUANCE

INVEST IN... *Insulations*

The return on the money invested in adequate insulation for boilers, steam lines and heated equipment is more than many people realize. It is not unusual to find that savings actually pay for a job in less than a year—with the return continuing, indefinitely, throughout the years that follow.

In selecting insulations, however, be sure to choose highly-efficient, long-lived, dependable materials . . . such as Ehret's 85% Magnesia or Enduro. This will ensure the permanency of your investment as well as a continuously high rate of return on your insulation dollars.



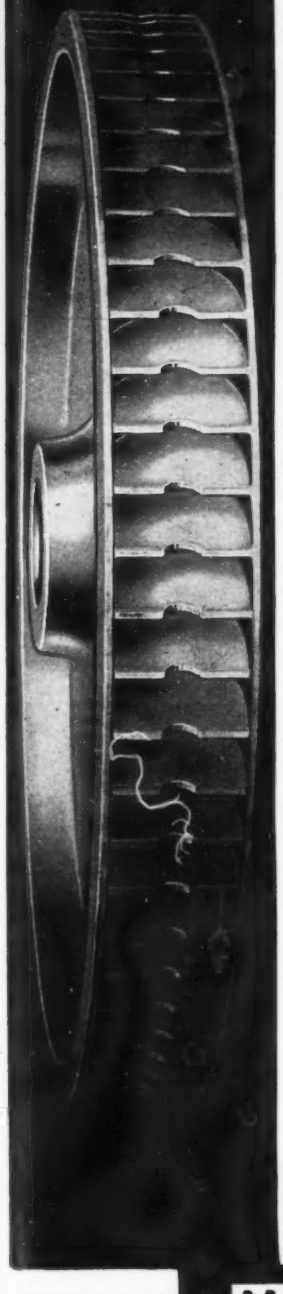
THE EHRET HEAT INSULATION HANDBOOK *contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations—with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. A copy will be sent at your request.*

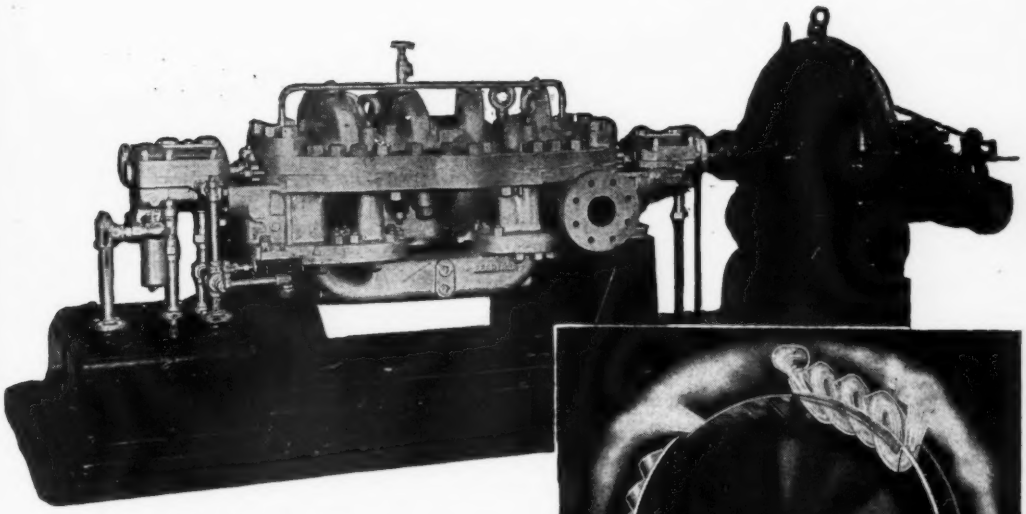
EHRET

MAGNESIA MANUFACTURING CO.

VALLEY FORGE • PENNSYLVANIA

TERRY





A DURABLE . . . EASY TO OPERATE AUXILIARY DRIVE STEAM TURBINE

Pictured above is a 125 HP Terry Solid-Wheel Turbine direct connected to a centrifugal pump. The turbine wheel of this unit is shown at the left and the action of the steam in the wheel is shown at the right.

This rotor construction offers many advantages:

— The blades and the wheel are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances and are double rim protected so that it is impossible for the blades to rub.

— Due to the generous blade clearances, it is not essential that frequent inspections of the thrust bearing be made.

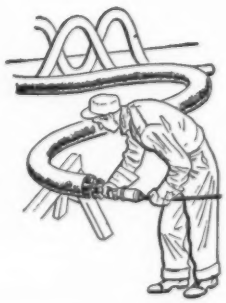
For full details ask for Bulletin S-116.

T-1160

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

ACCURATE WORKMANSHIP

The measure of any piping system, after the proper design has been reached, is the "fit". The knowledge which we have gained in the past 40 years is your guarantee of an accurate and workmanlike piping system. Navco quality in workmanship and design is evidenced by the many successfully operating installations which we have made for every industry. Consult Navco for your next piping job.



NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

8 to 1 STEAM CAPACITY RANGE FIRING PULVERIZED COAL IN A TOTALLY WATERCOOLED FURNACE

Peabody

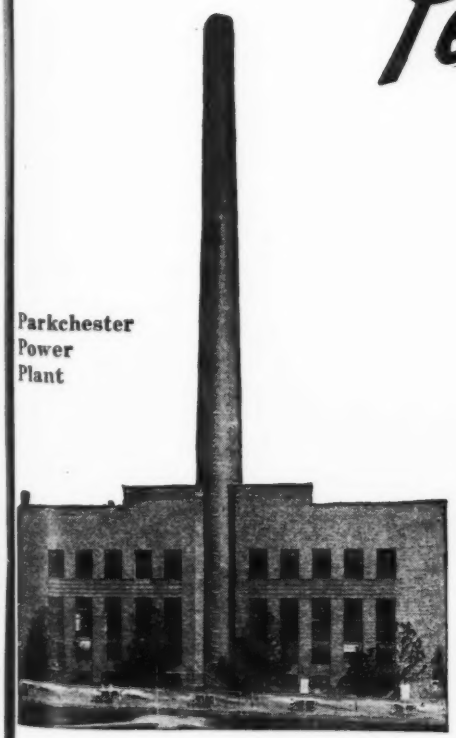
Combined Burners at PARKCHESTER

The Peabody Pulverized Coal Burner is a practical and satisfactory companion to the widely known and accepted Peabody Constant Differential Wide Range Oil Burner.

At Parkchester, New York City, two Peabody Combined Coal and Oil Burners fire each of the four boilers. They deliver a maximum of 135,000 pounds of steam per hour per boiler, firing oil, and 110,000 pounds firing pulverized coal.

When burning coal, the minimum capacity is below 15,000 lbs. of steam per hour, a range of 8 to 1. Efficient fuel-air mixing at all loads assures proper combustion in a relatively cold furnace.

Results like these are behind the preference for Peabody combustion equipment. If you have a problem involving conversion, replacement or a new installation, discuss it with Peabody.

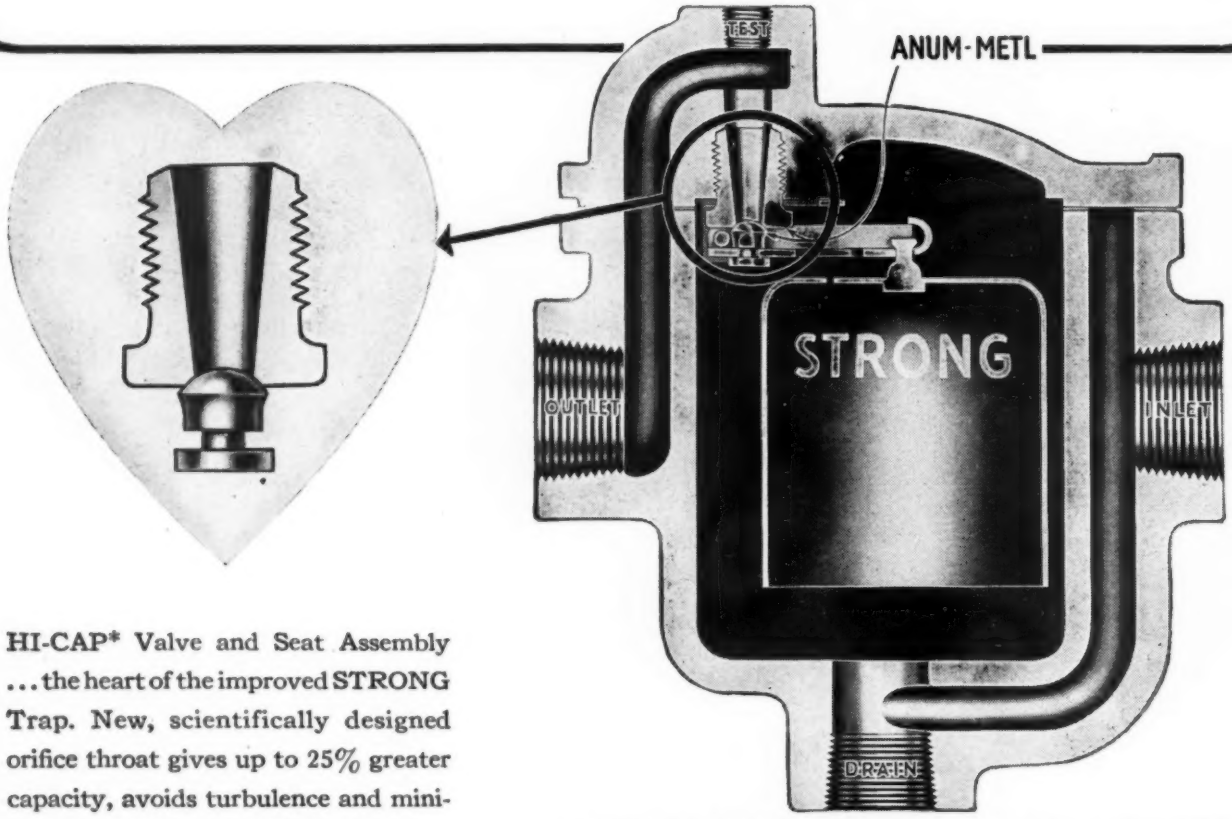


Parkchester Power Plant

PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK
OFFICES IN PRINCIPAL CITIES

New HI-CAP Orifice Gives STRONG Traps

UP TO 25% GREATER CAPACITY



HI-CAP* Valve and Seat Assembly ... the heart of the improved STRONG Trap. New, scientifically designed orifice throat gives up to 25% greater capacity, avoids turbulence and minimizes choking caused by flash steam.

*HI-CAP—Registered trade mark

An important part of STRONG service is continued attention to parts for traps in service. HI-CAP parts are available for your present 70 series traps.

OTHER FEATURES OF THE NEW HI-CAP TRAP

NEW lever design gives quick, full opening without dribbling.

NEW renewable seat permits easy servicing.

NEW inlet-outlet location places trap below level of inlet pipe at all times.

Write for New Bulletin on HI-CAP Traps

STRONG, CARLISLE & HAMMOND COMPANY

Over 40 Years of Steam Specialties

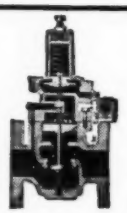
CLEVELAND 13, OHIO

REG. TRADE MARK

OTHER ANUM-METL Reg. Trade Mark

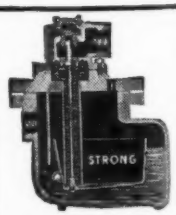
STRONG

STEAM SPECIALTIES



Reducing Valves

Strainers



Large Capacity Traps

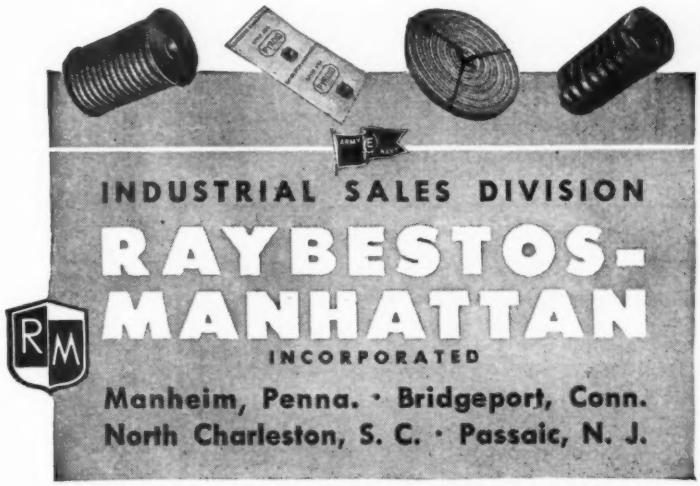
A LONG-TIME CURE FOR PACKING AILS

Ever figure what a small leak costs? With leaks it isn't the initial cost, it's the up-keep that really mounts into money. Leaks keep up the up-keep twenty-four hours a day, seven days a week. They never loaf on the job, or take the afternoon off. They waste valuable materials. Often, they cause serious plant hazards.

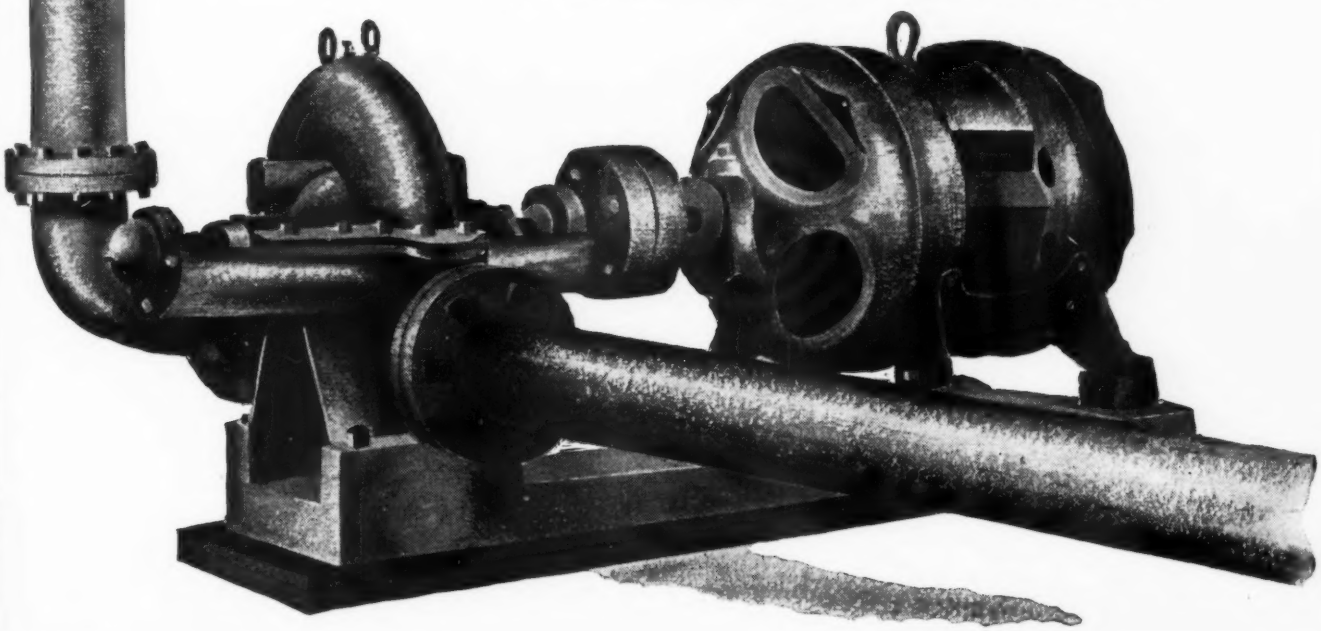
R/M packings provide a long-term cure for leaks.

They stop leaks of steam, air, gas, water, or any other fluid. There are more than 73 different kinds of R/M packing for pumps, pistons, valves, flanges, and other types of service.

Each different R/M packing comes in a wide range of sizes, and is backed by more than forty years of packing experience. For a packing prescription that will cure what ails leaking lines, specify R/M.



It's "Packed with Satisfaction"—When You Use R/M

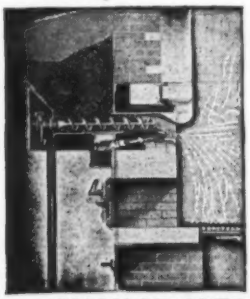


FYR-FEEDER STOKERS

MULTIPLE SPREADER

BURN COAL LIKE OIL!

Save with Fyr-Feeder—Burn less Coal—Cheaper coal—Local coals—Screenings—Coal yard sweepings, wet or dry—Wet coal is no handicap.



FYR-FEEDER

exclusively uses

Air JET Coal PROPULSION

Fines burn in suspension, larger pieces are spread evenly over grates.

Fyr-Feeder increases boiler capacity—responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes firemen's work much easier—no banking losses.

CHANGE OVER TO FYR-FEEDER NOW!

Easily installed in minimum time.

Fyr-Feeders are built in sizes to burn from 300 to 12000 lbs. of coal per hour. If you are or expect to be in the market for automatic coal burning equipment.

Wire or Write

FYR-FEEDER Stoker Division

AMERICAN COAL BURNER COMPANY

Engineers

32-18 E. Erie St. **Chicago 11, Ill.**

Heavy Duty Plastic Makes

SOLID FLOOR PATCH

INSTANTLY...No Wait for Setting!

FREE TRIAL OFFER

Tamp Smooth! Truck Over!

Now you can restore broken concrete to solid smoothness without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

REQUEST DESCRIPTIVE FOLDER and Details of FREE TRIAL OFFER

INSTANT-USE

FLEXROCK COMPANY

3677 Filbert St., Philadelphia 4, Pa.

Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.

Name .....

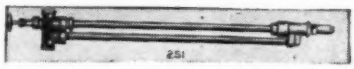
Company .....

Address .....

For *EVERY* LIQUID FUEL THERE IS A

NATIONAL AIROIL BURNER

The complete, widely used National Airoil line includes burners fabricated of a diversity of metals to withstand the actions of *every* liquid fuel, using all types of atomization at different temperatures; built in various rated capacities and designed for all pressures.



To burn the very cheapest and lowest grades of heavy fuel oil or tar, requiring lower oil pressure and lower oil temperatures, use the Type SA—Steam or compressed air atomizing type.

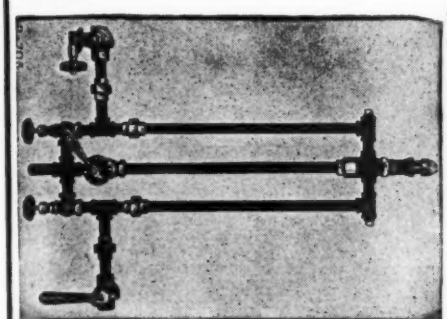
Fig. P-635A

To burn tar or pitch, use the high pressure steam or air atomizing Type SAR.

No matter what your service indicates — we have the correct burner.

To generate steam at large capacity, etc., use the Type SAL.

BURNERS . . . for all commercial grades of fuel oil using all types of atomization; to operate with either high, low or gravity oil pressure; for high capacity up to 750 gallons per burner per hour —using steam, air or pressure atomization.



To burn acids or caustic oil; sludges, asphalts, tank bottoms, Polymer oils, heavy petrolatum, organic oil residuum, waste cutting oils, sulphite pulp liquors, etc., use the Type SAD. It eliminates noxious fumes and stack solids; steam or compressed air atomizing.

BURNERS . . . of all bronze — for acid oils or acid sludges; of all steel—for petroleum pitches and coal tars at temperatures up to 800° F.

With nearly 35 years' experience in the design and manufacture of fuel oil and gas burner equipment, we have a solution to *your* combustion problems.

NATIONAL AIROIL BURNER

COMPANY, INCORPORATED

1250 East Sedgley Avenue

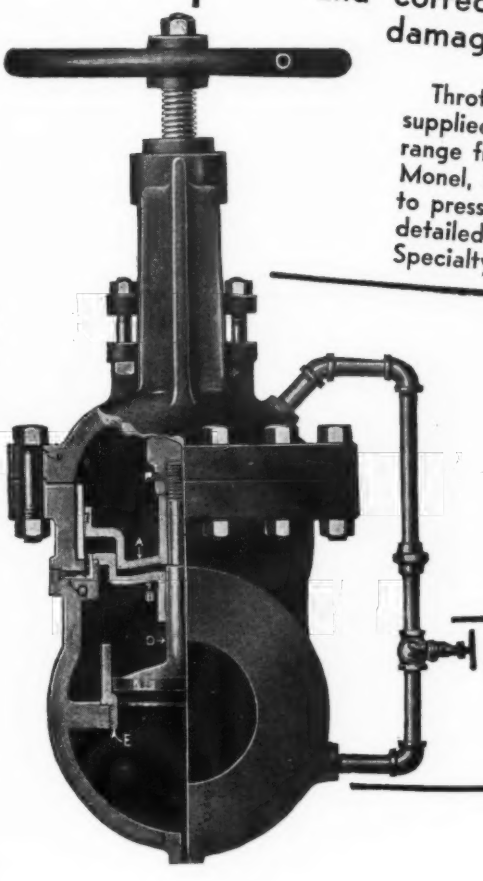
PHILADELPHIA 34, PENNA.

OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS
EXPLOSION DOORS • ACCESS DOORS • AIR DOORS
BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

GET THIS AUTOMATIC PROTECTION AGAINST RUNAWAY TURBINES!

Eliminate any possibility of engines or turbines exceeding maximum safe operating speed by installing GOLDEN-ANDERSON Throttle and Emergency Stop Valves. These valves will act as "sentinels" in your plant and in the event of a runaway turbine, they'll automatically shut off—thus permitting location and correction of the trouble before damage occurs.

Throttle and Emergency Stop Valves are supplied in Angle and Globe Patterns. Sizes range from 2½" to 16". Trim may be Bronze, Monel, Stainless Steel or Gallavoy, according to pressure and temperature conditions. For detailed information on the full line of G-A Specialty Valves write for our catalog.



GOLDEN-ANDERSON
Valve Specialty Company
PITTSBURGH PENN.

Manufacturers of Special Valves for Special Requirements

John Zink Combination Burners

are Ideal for

POWER BOILERS

Burn either or both gas and oil with the same heat pattern.

FEATURE: Independently removable fuel guns — Feather weight type, one man can remove for service while boiler remains in service. Easy to operate. Simple in construction.

Write for illustrated literature

JOHN ZINK COMPANY

TULSA, OKLAHOMA

342 Madison Ave., New York, N. Y.

Let's get acquainted!

This is the first time we have met in this publication. During the months to come we know we will meet many old friends for after 25 years of making pressure reducing valves for people, valves that meet their exacting specifications, you do make a lot of friends.

But we also hope to meet, get to know, and be able to help many NEW friends. People who, like our friends of the past, need a valve they can buy with confidence.

Write for our NEW 28 page catalog and learn how CASH-ACME products can best serve you.

A.W. CASH VALVE MFG. CORP. DECATUR 6662 EAST WABASH AVE. ILLINOIS

Mr. Fillet Weld is the friend of the working man. He helps make walk-ways and stair treads better working places...

for these reasons:

1. Safer—the Fillet Welded Hex Bar design makes BATES • GRATES safer. The crisp edges shed grease, dirt and water—reducing chances of accidents.

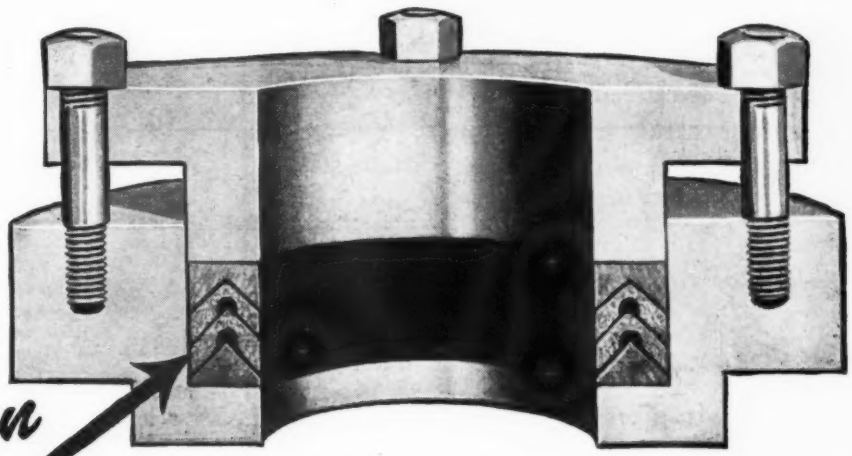
2. Better lighting—the reflecting bevels of the Fillet Welded Hex Bars, with 90° corners, allow maximum transmission of light through the grating. There are no "dungeons" underneath BATES • GRATES.

3. Better ventilation—the Hex design not only promotes good lighting but also provides good air circulation, thereby increasing working comfort.

for open steel flooring, stair treads, floor armor and bridge decking : . :

Get a bid from Bates

Why Garlock CHEVRON Lasts Longer



It's the hinge-like construction

CHEVRON EXPANDS AND CONTRACTS WITH VARYING PRESSURES...

Garlock Chevron is not just an ordinary "V" type packing. It has an exclusive hinge-like construction which permits automatic expansion and contraction. The packing expands as the pressure increases and contracts as the pressure decreases. Friction on the rod and on the packing itself is thereby reduced to a minimum. Long, dependable service results—frequent shut-downs for re-packing are avoided—production increases—operating costs are reduced. You'll like CHEVRON!

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Quebec

Garlock 430 CHEVRON for hydraulic service.
Garlock 431 CHEVRON for oils at low temperatures.
Garlock 530 CHEVRON for steam, air or gas.
Garlock 531 CHEVRON for hot oils.

Garlock

Here's why

AIRETOOL
TUBE CLEANERS & EXPANDERS

SAVES TIME · SAVES TUBES · SAVES MONEY

Driven By More Powerful Motor

Airetool Tube Cleaners are driven by a power seal motor that develops 28% more power. It can be loaded down to 50 rpm without stalling. Has slip fit construction for easy maintenance. (For tube sizes ½" to 24" I.D., straight or curved.)

New Form Cutters

New Form Cutters are made of special heat treated alloy steel, for prolonged usage. They are designed to remove severe deposits in tubes quickly and efficiently without tracking. Made in a variety of styles and sizes.

Tough Tube Expanders

Airetool Tube Expanders are made of heat treated alloy steel for endurance. No tube expanding job is too tough for them. Available in many styles and sizes.

Write Dept. P For Helpful Bulletins

Airetool & Yost Superior Factory Bldgs.

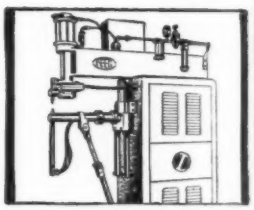
SPRINGFIELD, OHIO

AIRETOOL MANUFACTURING COMPANY

Now! Projection Welding of Two Studs to Housing in One Operation!

The series of P-20 Peer Welders were developed to provide manufacturers of sheet metal and wire products with automatically air operated machines capable of high speed precision projection and general spot welding. They are sturdily constructed, low priced, direct air operated, press type machines.

Shown above, is a Peer P-20 set up with safety guard which is so adjusted that, when lowered, it trips the switch and causes the welder to pass through a complete welding cycle before the machine automatically lifts the guard and stops, ready for the next operation. Other means such as a foot-switch control, can also be used to actuate the welding cycle.



Air Operated
Press Type Spot Welder

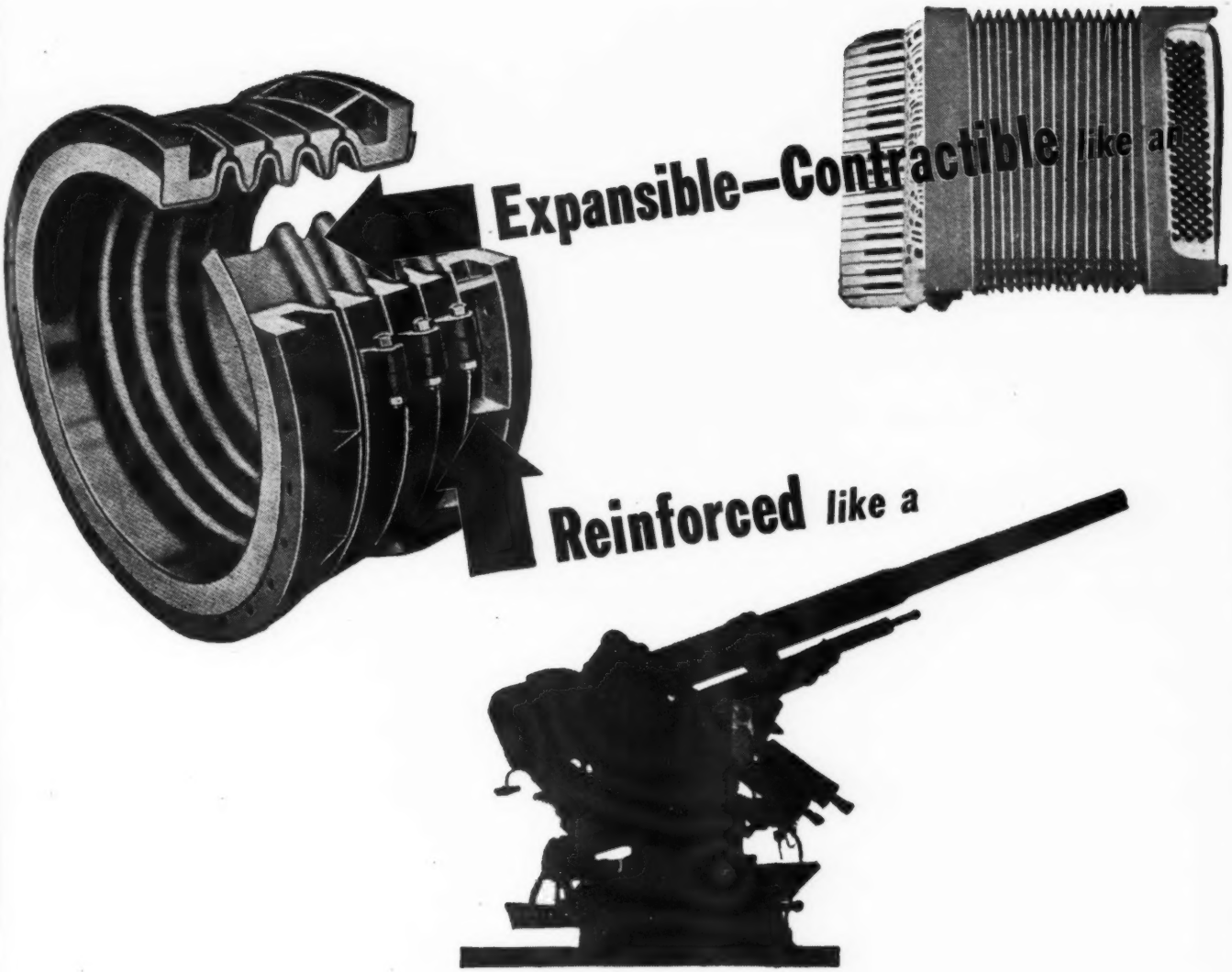
The standard cylinders furnished with these welders provide nominal electrode force up to a maximum of 1000 lbs. Pressures are easily adjusted by the air pressure regulating valve. The welders may be operated with strokes suitable for work at hand within the range of from 0" to 3".

Shown at right, is the wrapper from a package of Wrigley's Spearmint Gum. This famous wrapper will remain empty until conditions permit Wrigley's Spearmint manufacture in quality and quantity for everyone. Wrigley's Spearmint Gum, will, one day, be back as "a help on the job" to workers in industry. Until then, we ask you to remember this wrapper as a guarantee of finest quality and flavor in chewing gum!

Remember This Wrapper

You can get complete information from
Pier Equipment Mfg. Co.,
8 Milton St., Benton Harbor, Mich.

Z-83



Yet these similes tell only half the story of what makes the Badger Packless Self-equalizing Expansion Joint the strongest, most dependable and longest lasting product of its kind in the world:

As the reinforcing sleeve of a heavy gun protects the barrel and helps to send the force of the charge in the right direction, so do the protecting ALL-CURVE Equalizing Rings direct the flexing of the ALL-CURVE Corrugations of the Badger Expansion Joint illustrated here.

With corrugations and rings in "synchronized" ALL-CURVE design (exclusive with Badger), flexing stresses are distributed evenly. Stresses cannot "pile up" in any one or more corrugations. Neither are there any angles or "junctions" in which stresses can localize.

Result: No excessive strain anywhere, any time. The flexing member has ample freedom of movement to absorb all expansions and contractions within the prescribed limits of the joint.

Packless construction—due to forming the flexing member from a single piece of tubing—eliminates the need of packing and, consequently, costly packing maintenance, tunneling and manhole construction. *Special heat-treatment,* after forming, preserves flexing qualities and lengthens life.

COPPER or STAINLESS STEEL. Copper for normal pressures and temperatures. Stainless Steel for higher requirements—and where corrosion is a problem. Available in single and multiple corrugations—for traverses from a fraction of an inch upward. Also made in non-equalizing type (without rings) for uses that do not require this added protection.

SEND FOR FREE BULLETIN No. 100

E. B. BADGER & SONS CO., 75 PITTS ST., BOSTON 14, MASS.

Agents in Principal Cities

Badger

PACKLESS CORRUGATED EXPANSION JOINTS

IF IT'S BADGER-MADE IT'S GOT SOMETHING!

HOPPES
FEEDWATER HEATERS

Deaerating and Non-Deaerating

Write for Bulletin

THE HOPPES MFG. CO.

Established 1881

SPRINGFIELD OHIO

GRATE-Economy!

Increase Boiler Ratings at a Savings *with*

MARION MASTER GRATES

• With efficient grates, coal waste is eliminated, boiler efficiency increased. MARION MASTER GRATES show immediate savings in fuel costs and send boiler ratings up. Clean fires assured with all grades of coal.

Experienced workmanship and superior materials give strength and durability to MARION MASTER GRATES.

FEATURES

• Long Life of Bars Due to Depth of Center Rib—NO WARPED BARS!

• Permanent Pins—Steel Trunnion Pins Cast Into the Bars!

• Easy Operation—Smaller Bearing Surface of Pins Allows Easy Rocking.

HERE IS TRUE GRATE ECONOMY! WRITE FOR BULLETIN G-45.

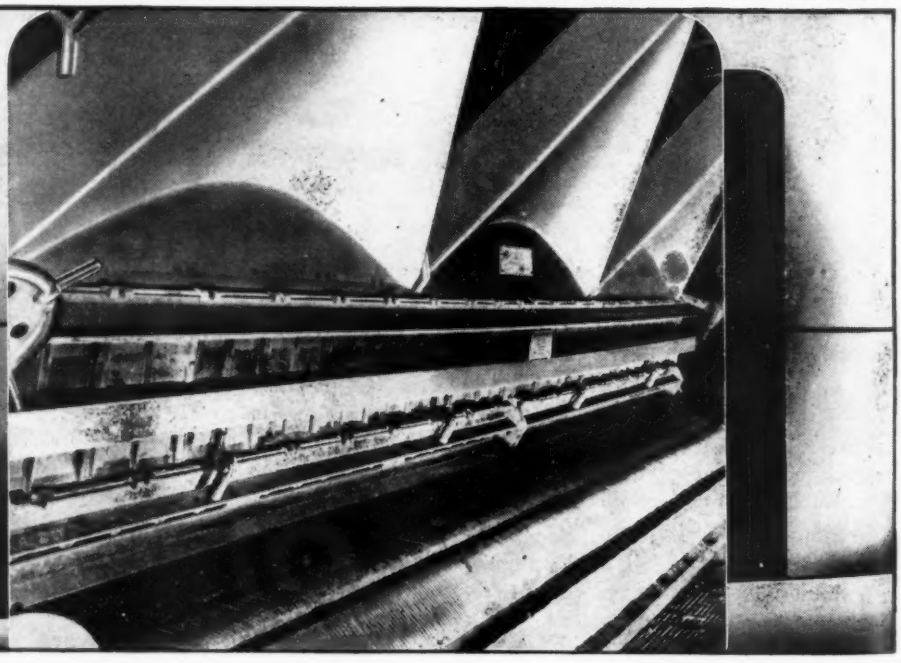
Grates to Suit All Conditions.

THE MARION LINE

MARION MACHINE, FOUNDRY & SUPPLY CO.
Marion, Indiana, U. S. A.

HAVING TROUBLE WITH COAL SEGREGATION ON SPREADER STOKERS?

CONICAL Distributors Insure Uniform Distribution

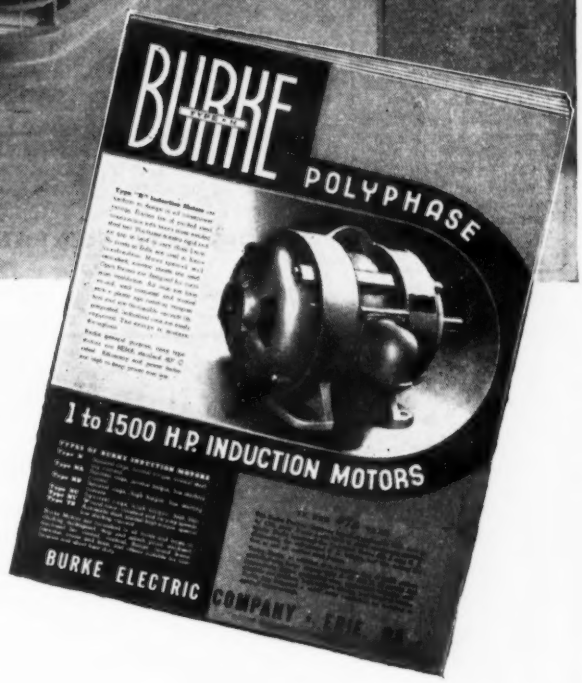


STOCK
ENGINEERING CO.

The CONICAL Coal Distributor is built to eliminate segregation. It distributes coal evenly, regardless of its size or shape, thus you get more power per pound of fuel and lower maintenance costs. Write for bulletins. Address Stock Engineering Co., 715 Hanna Bldg., Cleveland, 15, Ohio.

S.E.Co. Coal Valves and Coal Scales, CONICAL Non-Segregating Coal Distributors

BURKE MOTORS DRIVE MAIN SEWAGE PUMPS



At Bowery Bay

NEW YORK CITY'S MODERN, ACTIVATED-SLUDGE, SEWAGE TREATMENT PLANT

BURKE MOTORS perform one of the most important functions in this new plant, that of driving the main pumps which deliver the raw sewage from the incoming lines to the treatment process.

Dependable - - efficient - - rugged describes these motors. Dependable - - for continuous trouble free service. Efficient - - for low operating cost. Rugged - - for long life.

These motors are - - Wound Rotor, adjustable, varying speed-vertical type with welded steel frames, oil lubricated ball bearings, solid shafts, drip proof covers and high ring bases. Stators are designed for operation on 208 volt, 60 cycle, 3 phase power supply.

The two motors in the foreground are 400 HP at 400 RPM while the two motors in the background are 200 HP at 600 RPM. Motor speeds are varied between 85 and 100 percent to maintain the most efficient suction head on the pumps. Motor speed controls are automatically actuated by a wet well float.

Burke builds all the type and sizes of polyphase induction motors from 1 to 1500 HP. We have a background of over 54 years of specialized motor experience enabling us to make sound recommendations. Write for booklet 101-A to get acquainted with Burke induction motors, and send us your next motor problem.

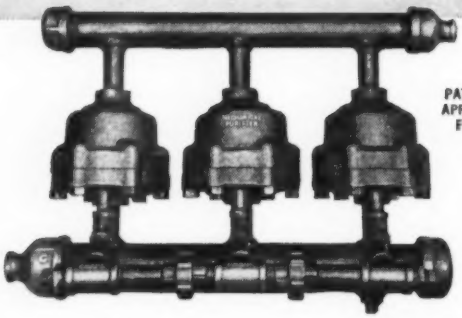
259 West 12th St.

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

Purify Any Pressures, Air or Gas, with Bird-White Multiple Unit *Pur-O-fier*



PATENT APPLIED FOR

Three Models Available

Model A-1 furnished with a 1 inch turbo-rotor and will accommodate volumes from 1 to 8 cubic feet.

Model A-2 has a 2 inch turbo-rotor and can accommodate volumes from 10 to 35 cubic feet.

Model A-4 has a 4 inch turbo-rotor and can accommodate volumes from 35 to 100 cubic feet.

Bird-White multiple unit Pur-O-fiers save time and money by protecting air-operated machines, gauges and controls from contamination. They give positive purification to air or gas lines regardless of fluctuating pressures or high volumes.

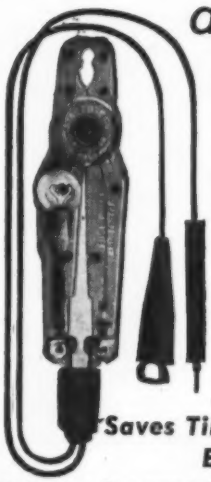
The perfectly balanced Turbo-Rotor purifying action makes them sensitive to both regular and intermittent pressures. Write for Bulletin 10 giving complete details.

BIRD-WHITE COMPANY

Dept. PM

3119 W. Lake Street • Chicago 12, Ill.

The STAR ★ Fuse Puller and Circuit Tester



DOES 3 BIG Jobs

1—Safely removes blown fuses
2—Quickly locates dead circuits
3—Replaces old-fashioned test lamps.

Indispensable for

Electricians
Engineers
Maintenance Men

Saves Time, Prevents Shock or Injury
Eliminates Guesswork

Made of a Transparent Plastic having in one of the legs a small lamp in series with a resistance and can be used to test 110 and 250 volts circuit. It will pull fuses from 10 to 100 Amperes. Thousands of electricians find this tool handier than Test Lamps. Requires the use of only ONE hand to quickly and accurately test circuits.

Lamp Is Replaceable

Manufacturers of power driven machinery supply these Pliers with their machines, and earn the thanks of the maintenance men and operators.

Retails at $2.75 each, $1.50 additional for Leads.

Can be obtained from General Electric or Westinghouse Stores; also from jobbers in every large city

STAR FUSE CO. 239 Canal St., New York 13, N. Y.

QUAKER PACKINGS...

Buy More
WAR BONDS

The time is rapidly approaching when the whistles will blast out the good news that will permit an easing of restrictions which have affected shipments to civilian users.

We hope it will be soon when prompt shipments can be made of all the rod and sheet packings you want.

It looks brighter now for more of our production becoming available for civilian use. This includes Rod and Sheet Packings as well as Belting, Hose and all types of Industrial Rubber Products.

Quaker all during the war has steadfastly turned out Industrial Rubber Products. It is good policy to keep on asking for Quaker—the name that stands for Quality Industrial Rubber Products.

If there is a way to get it done QUAKER will do it

Reg. U. S. Pat. Off.

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Mfrs. Industrial Rubber Products

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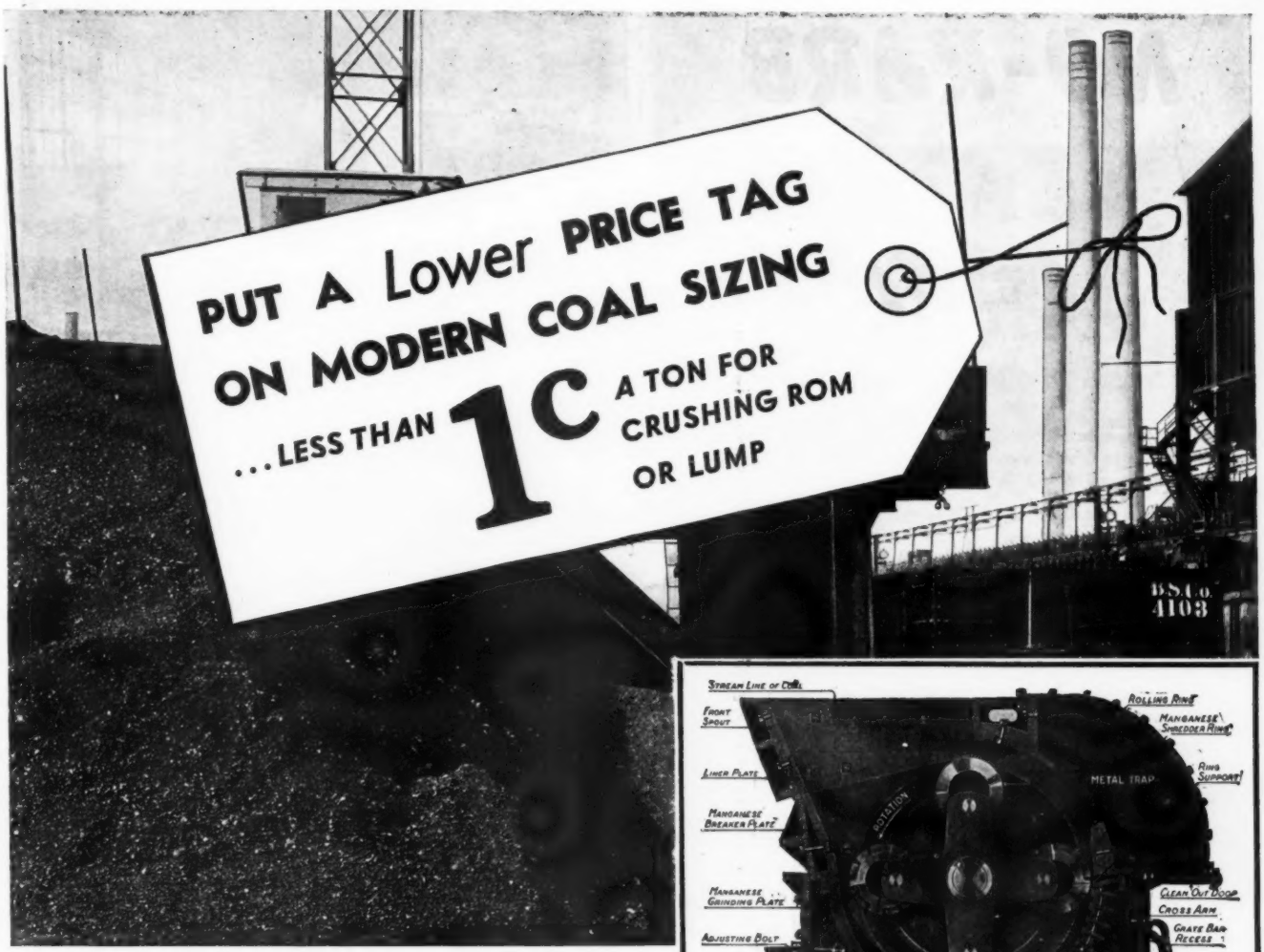

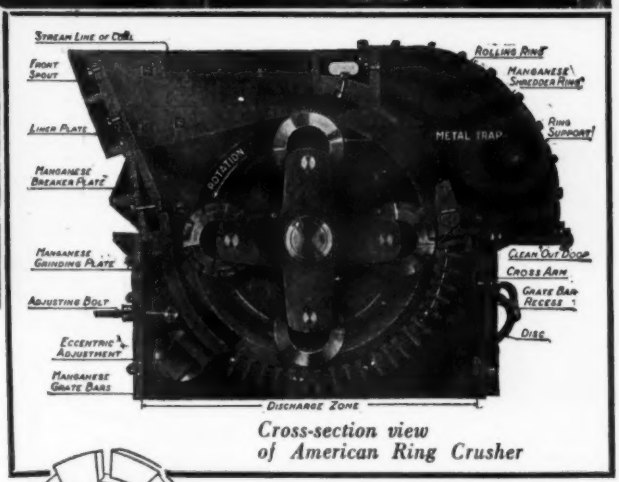

Cross-section view of American Ring Crusher

Handle the hard-to-prepare coals of today and tomorrow the easy "AMERICAN" WAY

With prolonged wartime restrictions on the flow of coal from one field to another, it appears that many boiler plants will continue to receive coal for which their equipment is not designed.

In making the best of these lower grade, hard-to-prepare fuels, why not do as scores of industrial plants and central stations are doing—insure better coal sizing the AMERICAN RING CRUSHER Way.

In one operation, the AMERICAN RING CRUSHER reduces run-of-mine or lump coal to sizes for stokers or unit pulverizers—at less than 1c per ton!

COAL IS SPLIT -NOT CRUSHED

A patented feature exclusive with American Rolling Ring Crushers—Manganese Steel Shredder Rings with 20 cutting edges. Revolving free at terrific centrifugal force, they deflect unharmed in contact with tramp metal. No shear pins or conventional safety devices that require attention.

Then, too, the AMERICAN CRUSHER is designed for simplicity of operation and freedom from breakdowns.

It will pay you to find out how AMERICANS will give you exactly the fineness of coal for your plant conditions and for top combustion efficiency.

Write for FREE Data Book on Coal Sizing

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1429 Macklind Avenue
St. Louis 10, Mo.

NO-KARB EATS CARBON

No-Karb, a granular compound, brings down the ignition point of soot and carbon to that of fuel (coal or oil), so that carbon and soot are consumed together with the fuel.

While boiler is in full operation, No-Karb is easily applied directly to the burning coals, or in the path of the oil-burner flame, where it volatilizes into a number of harmless gases. These gases literally consume soot and carbon wherever they have formed in boiler or tubes.

With soot and carbon eliminated, these additional benefits follow immediately: as much as one-third more heat from the same amount of fuel; pressure maintained easily and economically; manual cleaning either never required or required at longer intervals than ever before; longer life for quipment; black smoke sharply reduced. Write for specific application in your plant.

NUTMEG CHEMICAL CO.

Dept. P., 223 State St. New Haven 11, Conn.

COSTLY HUMAN ERRORS ELIMINATED WHEN YOU MEASURE VALUABLE STORED LIQUIDS With LIQUIDOMETER Tank Gauges

FOR GAUGING LIQUIDS OF ALL KINDS
100% AUTOMATIC
APPROVED BY UNDERWRITERS' LABORATORIES

WRITE FOR COMPLETE DETAILS

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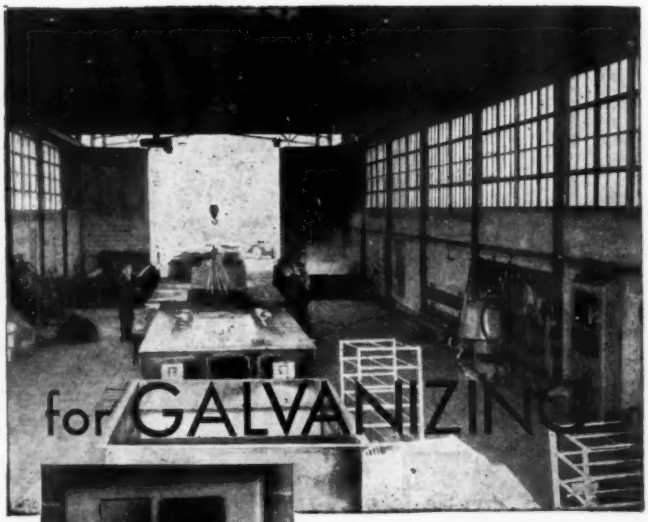
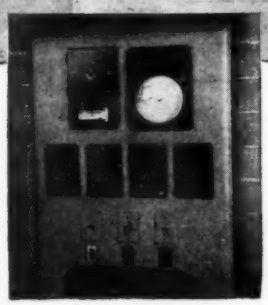
THE LIQUIDOMETER CORP.

39-16 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.





WHEELCO Potentiotrol holds Temperature within 1° F.

One of the largest galvanizing plants in the country (the Lang Company of Salt Lake City) solved the problem of maintaining the temperature of molten zinc at a precise level and protecting burners against flame failure, by the use of Wheelco instrumentation.

A Wheelco "Electronic Control Principle" Potentiotrol holds the temperature of a kettle containing 235,000 lbs. of molten zinc within 1° F. All galvanizing or regalvanizing is done to Navy specifications.

The galvanizing kettle is fired by four Hauck combination gas and oil burners. Protection from flame failure of the burners is maintained by four Wheelco panel mounted Flame-otrols, with Flame-eyes (oil) and Electrodes (gas). The Flame-otrols shut both main and pilot valves immediately upon flame failure, and prevent entry of fuel until pilot flame is re-established.

More than 30,000 Wheelco Instruments have been installed since January, 1943. This is further proof that with Wheelco you get the finest temperature control instruments available.

WHEELCO CONTROLS

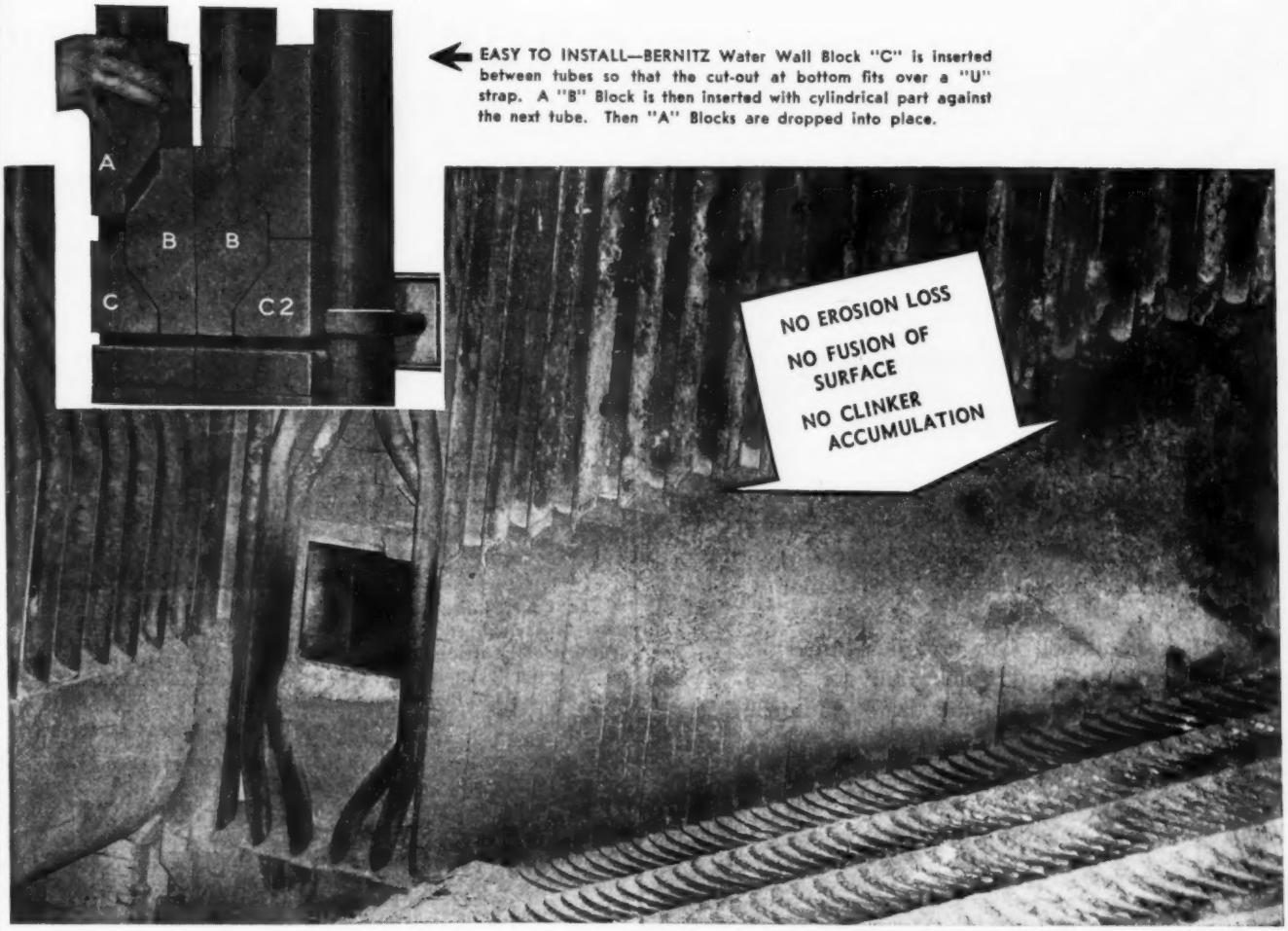
A complete line, including Flame-otrol combustion safeguards . . . Capacitrol pyrometer controllers . . . Indicating pyrometers . . . Proportioning controls . . . Program controls . . . and a wide range of accessories.

Ask for Condensed Catalog 26300

WHEELCO INSTRUMENTS COMPANY

863 W. Harrison St. Chicago 7, Ill.

WHEELCO



EASY TO INSTALL—BERNITZ Water Wall Block "C" is inserted between tubes so that the cut-out at bottom fits over a "U" strap. A "B" Block is then inserted with cylindrical part against the next tube. Then "A" Blocks are dropped into place.

After 4 years Rigorous Service these BERNITZ WATER WALL BLOCKS look like New

THE above actual photo from a 100,000 lb per hr boiler at a midwestern college tells a graphic story of the durability and economy BERNITZ Nygaard Water Wall Blocks are delivering in hundreds of boiler rooms.

Installing the BERNITZ Nygaard Water Wall Covering is a simple job. The interlocking blocks are assembled and dismantled from inside the furnace without any clamps or bolts. This material is used in the clinker zone of stoker-fired furnaces, or for any other application where it is desirable to cover the water wall tubes.

Note these practical advantages of BERNITZ Water Wall Blocks over cast iron, a material frequently used as an alternate to Nygaard construction:

1. "Carbofrax"* is highly refractory and its destruction temperature is much higher than that of cast iron. Then, too, cast iron must be maintained in intimate contact with the tubes by pressure or by permanent attachment to the tubes through integral casting or welding. If this pressure contact is not maintained with cast iron, its destruction temperature is soon reached.

2. It has a high heat conductivity which makes it very adaptable for water wall covering.

3. It has the property of resisting clinker and slag accumulation.

4. It has a notably high mechanical strength.

This BERNITZ Water Wall Covering is available in virtually all tube spacings up to 12 in., and for 2 in. 2¼ in., 3 in., 3¼ in. and 4 in. OD tubes.

Its flexibility of design means that a Bernitz Water Wall Covering can be added to or taken from after the original installation without disturbing the covering or the casing behind the water wall.

For further details about the construction and advantages of this and other BERNITZ refractories, write for Bulletin B-341. It points the way to better protection and economy for boiler settings.

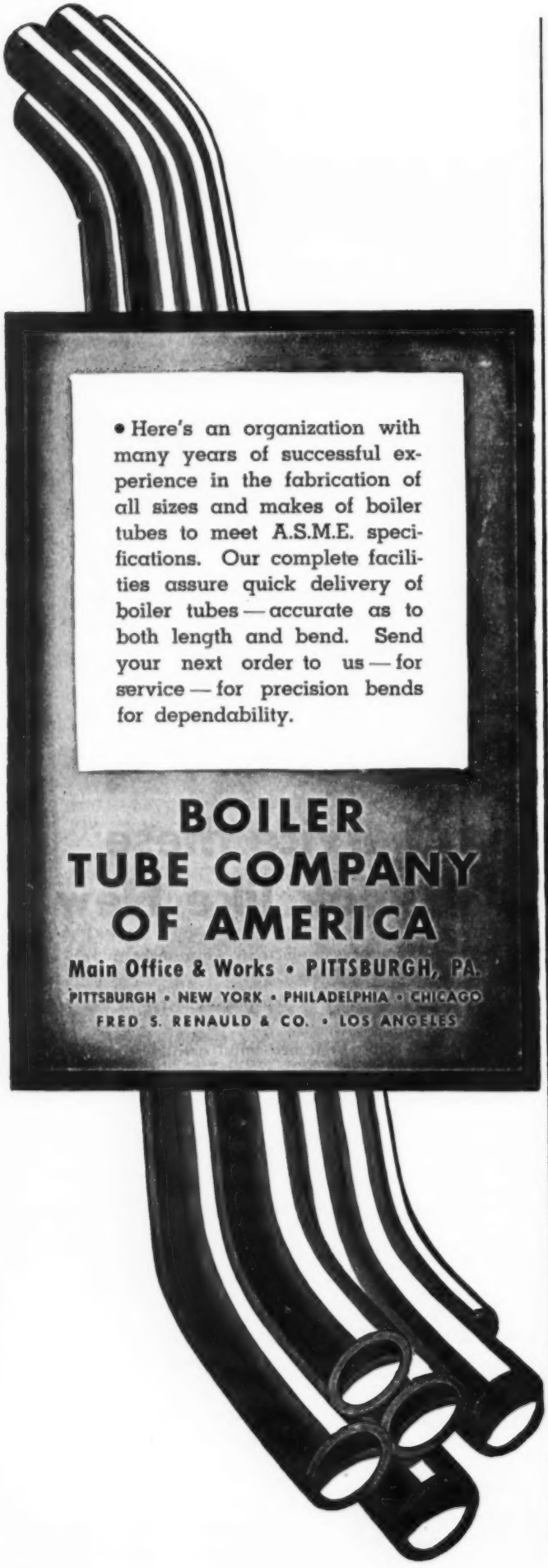
*"Carbofrax" is the registered trade mark of, and indicates manufacture by, the Carborundum Company.

BERNITZ FURNACE APPLIANCE CO. ● 89 BROAD STREET, BOSTON 10, MASS.

New York ● Philadelphia ● Detroit ● Buffalo ● Syracuse ● Atlanta ● Pittsburgh ● Cincinnati ● Chicago ● Indianapolis ● Minneapolis ● St. Louis ● Cleveland
In Canada: Williams & Wilson, Ltd., Montreal and Toronto

BERNITZ
NYGAARD WATER WALL BLOCKS

OTHER PRODUCTS INCLUDE:
BERNITZ FURNACE LININGS ● SUPER BLOCKS ● BLOCKS FOR WALLS AND ARCHES ● BERNITZ AIR-COOLED FLOORS ● BERNITZ SUPERGENERATOR LININGS FOR WATER SETS



• Here's an organization with many years of successful experience in the fabrication of all sizes and makes of boiler tubes to meet A.S.M.E. specifications. Our complete facilities assure quick delivery of boiler tubes — accurate as to both length and bend. Send your next order to us — for service — for precision bends for dependability.

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KNOW ELECTRICITY AS EXPERTS KNOW IT

—and get an expert's pay!

Just one new idea, one new fact, one new wrinkle, gotten from these practical books every day—and do you realize where you would be in six months or a year? Many men have backed up their experience in this way, to get in the big-pay skilled electrician class twice as fast. You can too!

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Can you answer these questions?

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3. Do you know enough about electric circuits to figure wire sizes, resistances, etc.?
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5. If you have to wire an old building with concealed wiring, do you know just how to go about it?
6. Do you know the National Electrical Code Rules and the reason for their adoption?
7. Do you have sufficient knowledge of mathematics to understand simple formulas, charts and graphs?
8. Do you understand the various factors or coefficients of electrical energy distribution systems used in central station practice and their application in the design and operation of central stations?
9. Can you complete a job of signal wiring, such as a fire alarm system or elevator system in a large plant?
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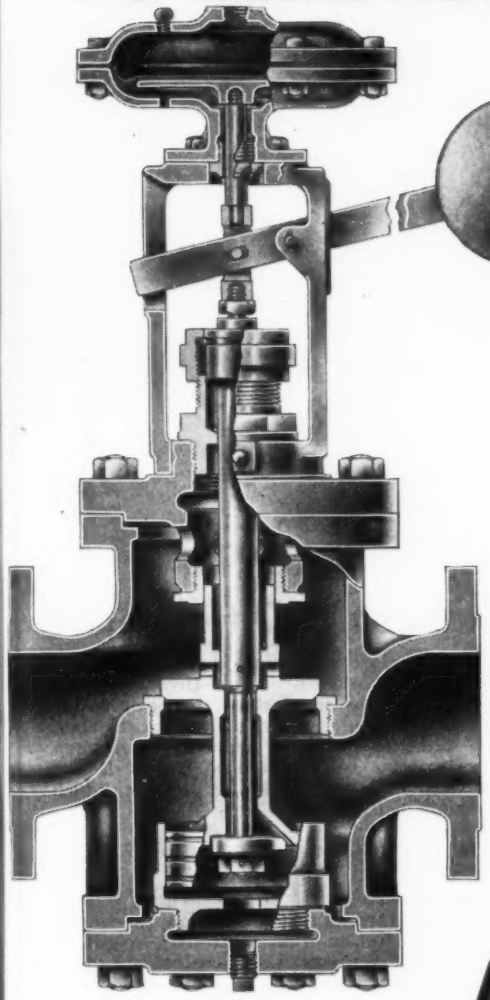
"Associated" IS A GOOD NAME TO REMEMBER—



SCHADE NO. 6060
Reducing Valve
Suitable for boiler pressures up to 250 lbs. psi. and reduced pressure from ¼ lb. to 10 lbs. psi.
Features:
Single seated — *absolutely tight shut-off.*
Balanced — *not affected by variations in boiler pressure.*

WHEN YOU WANT THE *exact* CONTROL FOR AN *exacting* APPLICATION

an associated company

*W*HERE you have a "fussy" control problem you want *more* than some valve that just "works" — you want the valve that suits the job *exactly*. That "right valve for the purpose" is part of what Associated Engineering stands for. It is specialization in helping you select the proper dependable controls for your specific applications.

The long and wide experience of Associated Engineers is available to you without obligation—why not send them your problem with details, or ask one to call on you?

MIPCO RELIEF VALVE — Class L, Series 50; forged steel, threaded ends; ½" to 1½" sizes.

MIPCO RELIEF VALVE — Class L, Series 100; cast steel, iron or bronze; 1" to 6" sizes.

Above controls are products of

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2527 No. Bodine St. Philadelphia 33, Pa.

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Associated Companies of

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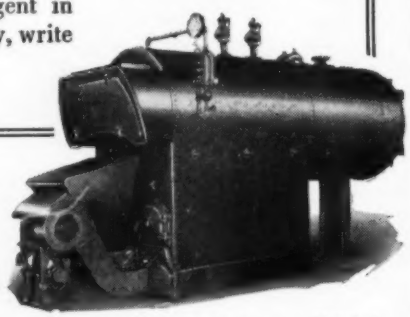
THE EVIDENCE IS NEAR YOU

BECAUSE so many Brownell boilers and stokers have been installed during the last 90 years, your local agent can show you Brownell installations in actual service and enable you to secure first-hand evidence from owners. Base your decision upon what you see and hear, but bear in mind that you will obtain the benefit of important improvements in the latest Brownell equipment.

If you do not know the name of the Brownell agent in your vicinity, write us.



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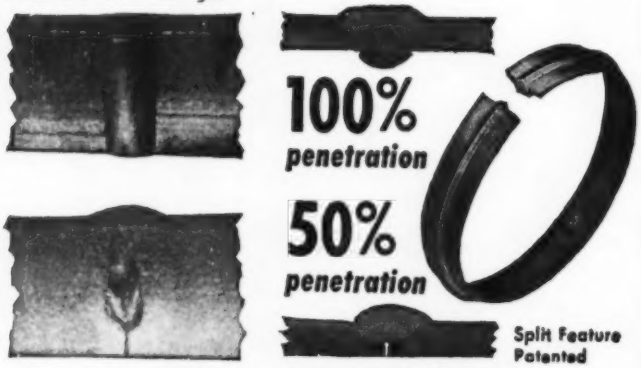
Brownell
COMPANY
306 N. Findlay St.
Dayton 1, Ohio

Brownell Boiler and Stoker as a Matched Unit—the Ideal Installation

REINFORCE Joints with WEDGE *Split* CHILL RINGS *and use* THIN WALL PIPE

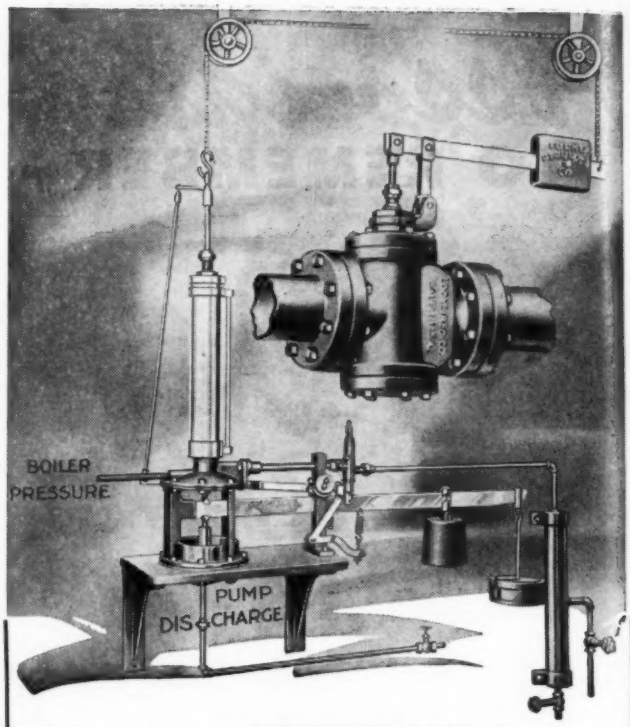
The use of WEDGE Chill Rings with the patented SPLIT Feature REINFORCES the joints and makes them the strongest part of the line. In case of shock, strain or vibration the reinforced joints will not leak or break. Because the joints are reinforced it is possible to use LIGHTER WALLED pipe — this saves money and makes a substantial reduction in weight. If you weld pipe or tube joints investigate WEDGE Chill Rings.



Write for circular and prices

WEDGE PROTECTORS, INC.
9524 Richmond Ave. Cleveland 5, Ohio

WEDGE CHILL RINGS SAVE MONEY



It's the DIFFERENTIAL That Makes the Difference!

Designed for very close regulation, this Locke Model 14 Excess Feed Line Pressure Regulator (hydraulic) has opposing chambers above and below the scale beam. Boiler pressure is connected to upper diaphragm chamber, and feed line pressure to lower diaphragm chamber. Weights on scale beam are balanced to secure desired differential between feed line and boiler pressure, which is constantly maintained.

— and these advantages make a difference in costs!

Water pressure operates the motor piston to control operation of dial switches or drum controllers to govern variable speed motor-driven pumps. When constant speed motor-driven pumps are used, this regulator governs a balanced regulating valve in either suction or discharge line at pumps, maintaining a constant excess pressure in feed line to boilers.

Its variable compensating device graduates all control movement to desired adjustment.

LOCKE ENGINEERS CAN ADVISE OF OTHER APPLICATIONS FOR THIS REGULATOR VALVE

Write us full details of your particular regulating problems and requirements.

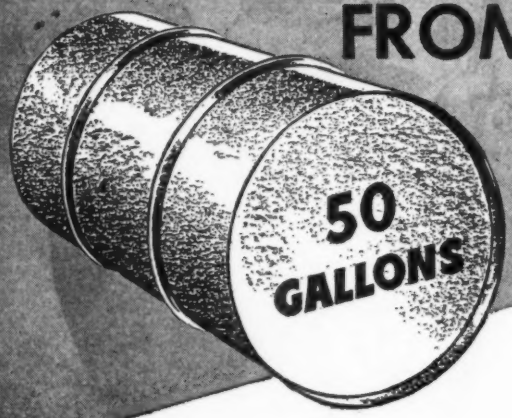
DIVISION OF THE H. T. WILSON MACHINE CO., INC.

LOCKE REGULATOR COMPANY

WALTER AND OSBORNE STREETS
SALEM, MASSACHUSETTS

MODEL REGULATORS · DAMPER REGULATORS · FAN ENGINE REGULATORS · BACK PRESSURE VALVES · BALANCED VALVES · ELECTRIC VALVES · REDUCING CONTROLS FLOAT CONTROLS · PILOT CONTROLS · PUMP GOVERNORS · VACUUM BREAKERS ENGINE STOPS · MASTER REGULATORS · OIL CONTROL VALVES · SOLENOID CONTROLS

ONLY GETTING 50 gallons OF OIL FROM A 50 gallon Drum?



You get HUNDREDS if you use THE YM OIL RECLAIMER!

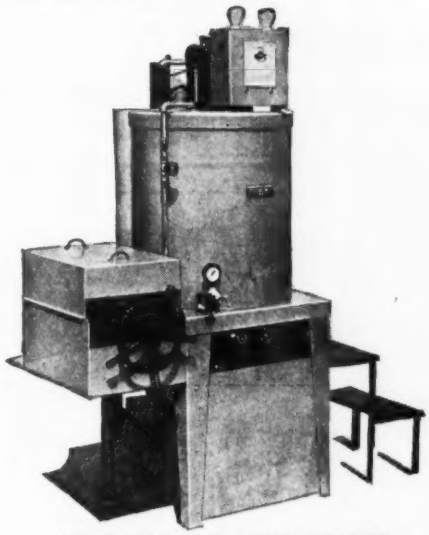
With the YM Oil Reclaimer, you can put used oil back to work...can use it again and again...and it's interchangeable with new parent oil!

The YM Oil Reclaimer completely removes fuel dilution... and moisture too, of course. It removes acids, gum, asphaltic materials. The oil comes out of the Reclaimer clear and sparkling — restored to the original viscosity of the new parent oil.

Oil refined in the YM reclaimer displays outstanding anti-varnish qualities. It cleans—*and keeps clean* —crank cases, valve chests and other places where sludge may collect.

Diesel and gasoline engine oils — transformer oils — cutting oils — hydraulic cylinder oils — these are just a few of the types that can be successfully reclaimed in a YM unit.

We'll be glad to show you how the YM reclaimer can cut *your* oil costs—and to tell you the names of companies near you who *know* what YM can do.



THE YM OIL RECLAIMER
One of the new models of the YM Reclaimer — available in a range of sizes for varying capacity requirements.

THE YOUNGSTOWN MILLER COMPANY

A Subsidiary of
Walter Kidde & Company, Inc.
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Save OIL...and you save MONEY
with the **YM OIL RECLAIMER**
MAIL THE COUPON FOR FULL DETAILS

The Youngstown Miller Company
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Gentlemen:
Please send me further details about the YM Oil Reclaimer—and names of users in this locality.

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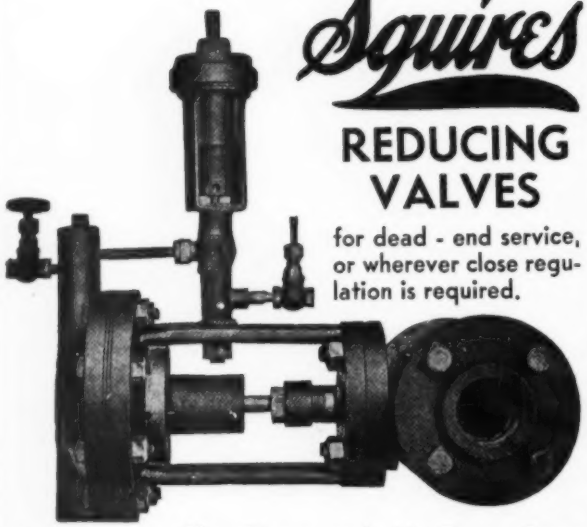
for dead - end service, or wherever close regulation is required.



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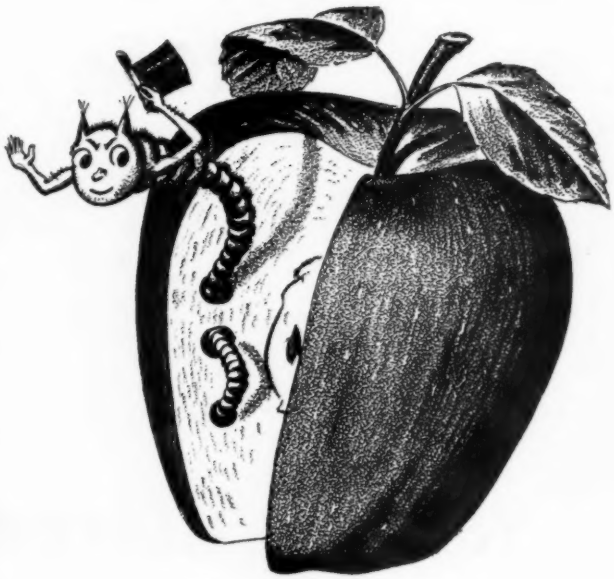
IN BOILERS, TOO
IT'S WHAT'S INSIDE THAT COUNTS



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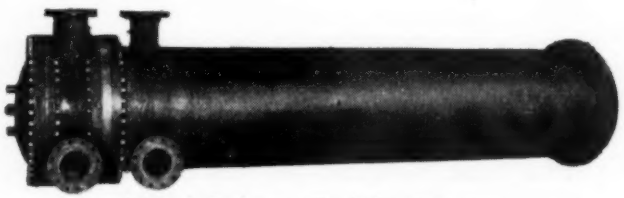
Strike at the core of boiler inefficiency! Control chemical concentrations with Whitlock's Continuous Blow Down Heaters. No matter how splendid your boiler may *look*, it must be free from foaming, priming and carry over if it is to do its full share of work. With the Whitlock Blow Down Heat Exchanger to reclaim heat from the blow down, you can deconcentrate continuously with minimum heat loss.



Whitlock Engineers will gladly survey your plant and make recommendations.

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Engineered to stay on the job!

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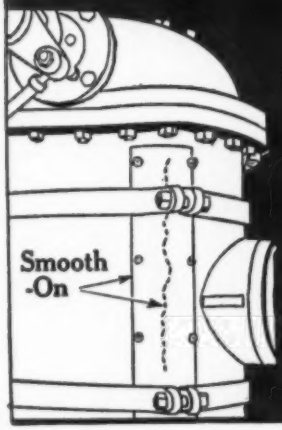
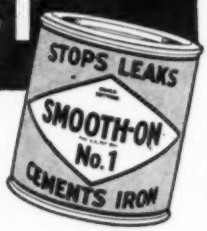
SMOOTH-ON No.1 SAVED COST OF NEW STEAM CHEST





THIS crack occurred in one of the worst possible spots in the casting, where steam pressure would have forced the crack wide open. The engineer first filled the crack tightly with Smooth-On No. 1 Iron Repair Cement, then bolted on an angle plate and reinforced it with supporting bands. The repair proved lasting, and the cost of a new high pressure steam chest and re-assembly was saved.

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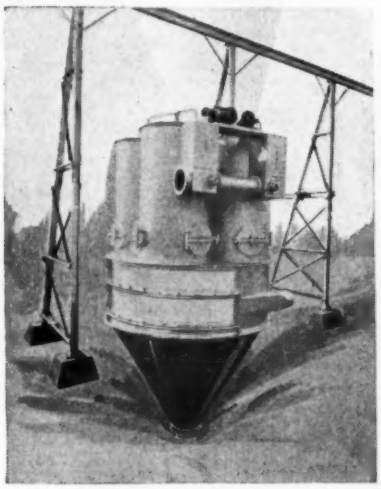

. . . used in connection with The Airveyor Conveying System for unloading fine grits from box cars and conveying to storage in a brewery. Rate of unloading 25 tons per hour.

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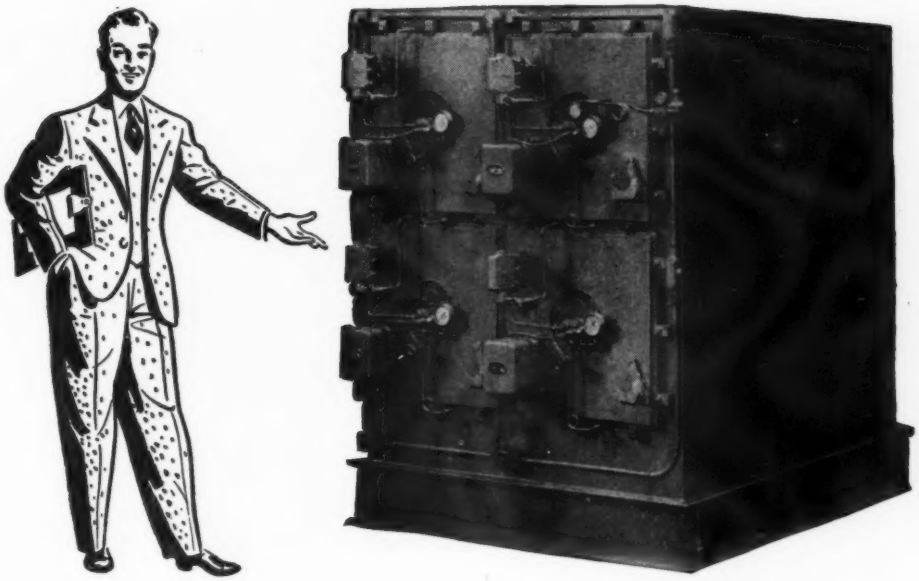

A typical Besler Sectional Boiler with rated steam capacity of 20,000 lbs./hr. at pressures to 1,500 lbs. psi and temperatures to 850°F. Weight is approximately 10,000 lbs.; boiler requires but 54 sq. ft. of floor space.

BESLER SECTIONAL BOILERS, a multiplicity of separately-fired forced circulation sections, bring for the first time the many advantages of the small forced-circulation boiler to users requiring large steam capacity . . .

1. Fast, Economical Installation. Requiring no field erection, special foundations, brick work or conventional stack, Besler boilers need only be moved into position and connected to plant lines for immediate operation.

2. "Packaged" Assembly. Compactness permits complete factory assembly, with all auxiliaries, burners and controls—everything needed for boiler operation furnished, from a single source, with undivided responsibility for satisfactory performance.

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4. Compactness, Light Weight. Approximately one-third the size and weight of natural-circulation boilers of comparable capacity.

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BESLER SECTIONAL BOILERS are manufactured in a wide range of types and rated capacities, for specific applications as follows: High Pressure Industrial Boilers, 2,500 to 50,000 lbs./hr.; Marine Boilers, 2,500 to 50,000 lbs./hr.; Low Pressure Industrial Boilers, 5,000 to 50,000 lbs./hr.; Test Boilers, 1,500 to 25,000 lbs./hr. Full information will be furnished promptly on request.

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Automatically controls circuit breaker closure of AC generators in paralelling to a common bus. Advantages are (1) greater accuracy, (2) quiet, (3) positive, (4) safe, (5) economical, (6) multiple control, (7) easily installed, (8) long life.

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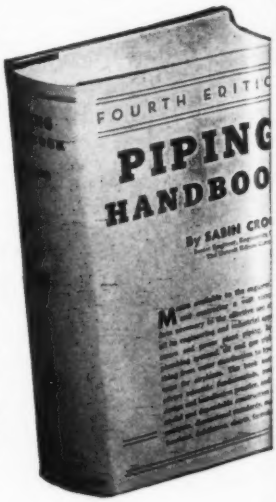
PANEL INSTRUMENTS • VOLTAGE REGULATORS • AUTOMATIC SYNCHRONIZERS • FREQUENCY REGULATORS

Complete, comprehensive guide to piping design and application

—The data and methods you need for solving every piping problem



HERE is an indispensable tool for the engineer, contractor, and designer, the famous PIPING HANDBOOK—now available in a new, up-to-date, fully revised, enlarged Fourth Edition. This vast compilation of data and methods for most effective use of piping puts at your fingertips all the principles that influence the design, construction and use of piping systems. *Any* fact, on any phase of piping practice, is here in clear, dependable, accessible form.

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By SABIN CROCKER

Senior Engineer, Engineering Division, The Detroit Edison Company

1376 pages, 4½ x 7½, 334 illustrations, 329 tables, $7.00

THIS vast handbook covering the fundamentals, materials, and techniques of modern piping practice is now enlarged by 500 pages, including four new chapters in line with the increasing importance of piping systems in industrial operations, with tables and charts, abstracts, standards etc. revised and improved, and scores of new facts and figures added. Now more than ever the PIPING HANDBOOK is an invaluable self-contained key to effective piping practice.

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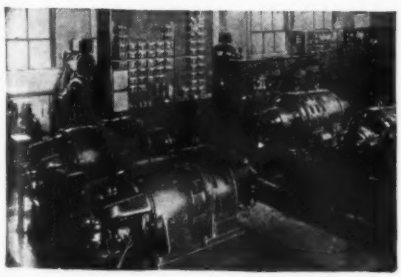
(Books sent on approval in the U. S. only.)

These beautifully designed, power-operated elevator doors replaced old-fashioned grille work.

4 ELEVATORS NOW DO THE WORK OF 5

The Michigan building in Detroit which appreciates the advantages of Otis Elevator Modernization.



Partial view of the penthouse machine room after Otis Modernization.

In the Michigan Building of Detroit, modernization of the elevator plant by Otis has resulted in marked improvements in elevator service *and worthwhile savings in elevator operating costs.*

Here's the story:

Originally, this building contained five Car Switch Gearless Elevators with open grille fronts and manually operated doors. All five of these elevators had to be operated at full capacity to handle the building traffic.

But, after being changed over to Otis Peak Period Signal Control, only four elevators were required to handle the traffic during busy periods. During slack periods, *only three cars were required.*

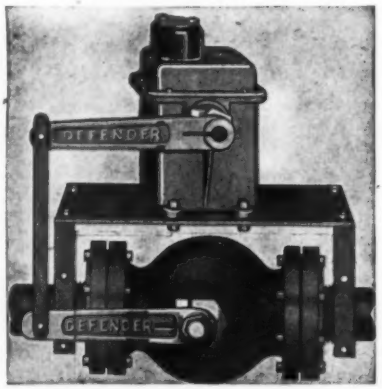
This is only one interesting example of the benefits of Elevator Modernization by Otis.

Whether your problems of vertical transportation are in Office Buildings, Department Stores, Hotels, or any other type of building, your Otis representative is ready to discuss modernization plans with you or your Architect.

For the finest in vertical transportation tomorrow, call your Otis representative TODAY.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

Defender Improved (Fitts Type) Adjustable Chronometer Valves



The longest lived Value made for Hot Water or Steam or any other corrosive Fluids that would soon wear out any of the Piston or single or double seated Valves.

This Chronometer Valve only requires an eighth turn to open and close and it can be Motor operated as illustrated above or it can be hand operated or float operated and we show in our new Bulletins E-3 & E-4 a complete line of Pressure and Vacuum Stats and Temperature Float and Liquid level as well as Feed Water Regulator Stats.

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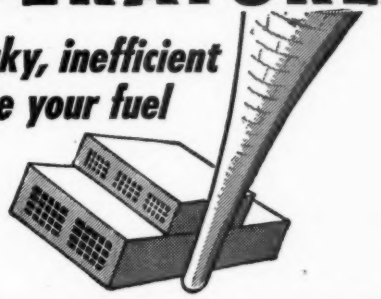
American manufacturers are already, or will soon be, seeking representatives in the newly-freed countries of Europe, and in Latin America, Africa and the Near East. If you wish to represent American makers of power equipment, accessories and supplies, please write to E. J. Tangerman, POWER, 330 W. 42nd St., New York 18, N. Y., U. S. A., indicating territories desired, products you wish to represent, present lines, if any, banking references and any other pertinent data.

WHAT IS *your* STACK TEMPERATURE?

Don't let leaky, inefficient baffles waste your fuel



IS your stack belching wasted dollars into the air in the form of excessive flue gas temperatures? If the temperature of your boiler exit gases is excessive, the likelihood is that the baffles are leaky, or inefficient in design, or both, and it will pay you to investigate Beco-Turner baffles.

Beco-Turner baffles are positively gastight due to the flexibility provided by their patented expansion joints as illustrated below. In each installation, they are designed to put into practice the most modern developments in baffle and furnace design.

Mail coupon below for facts about Beco-Turner baffles. If you will send blueprints showing your existing baffles, we will gladly submit recommendations for reducing stack temperature and saving fuel through improved baffle design.

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Please send facts about Beco-Turner baffles.

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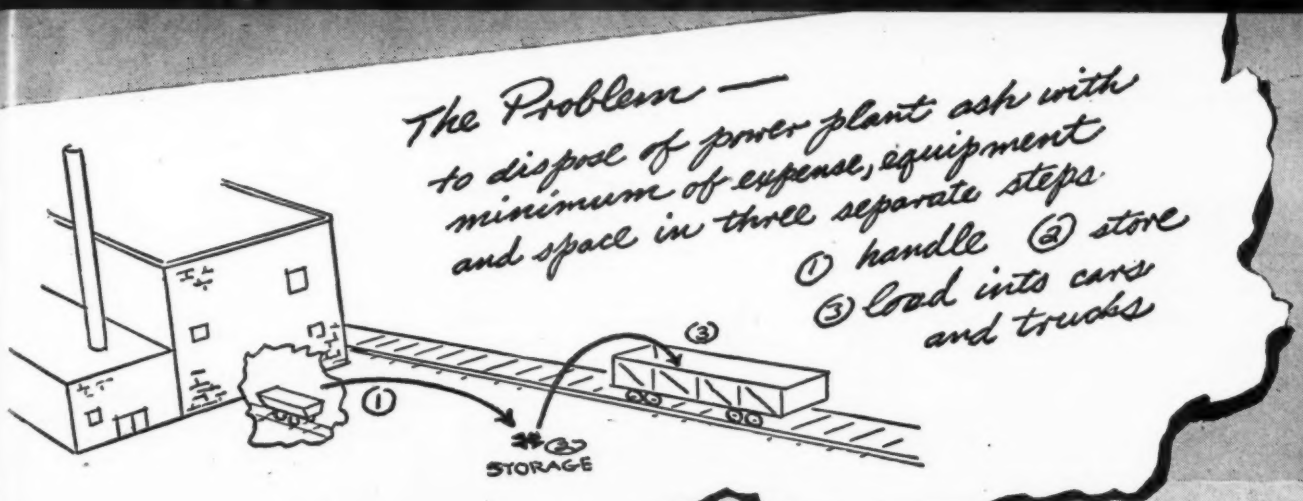
The Problem —
to dispose of power plant ash with minimum of expense, equipment and space in three separate steps
① handle ② store
③ load into cars and trucks
①
②
③
STORAGE

The Solution— AN S-A SKIP HOIST

★ Drawing on their vast background of perience and their complete line of material ndling units, S-A engineers met the needs of is power plant with the system shown.

Previously ash was collected in dump cars on basement track beneath the boilers. S-A recom- ended extension of the track, loading an S-A ip Hoist to carry ash to an overhead tile stor- e silo, from which it can be spouted to cars or ucks. The result is an installation that eliminates objectionable outside storage pile, eliminates handling and holds ash handling cost down.

An S-A Skip Hoist like this one can be used r practically any bulk material—lump or fine, rrosive or abrasive. It can lift materials to ights with a minimum of supporting structure. is simple in design, has a minimum of moving arts, and cuts maintenance to a minimum.

Whether your bulk material handling opera- ons call for a skip hoist or any other equipment, ll on Stephens-Adamson for a cost-reducing, me-saving installation.

Photo shows S-A Skip Hoist for raising ash to storage silo. Operation is semi-automatic, with the hoist started, elevated, dumped and returned for a new load by push button control.

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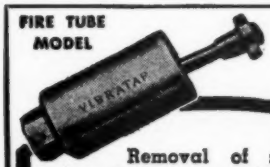

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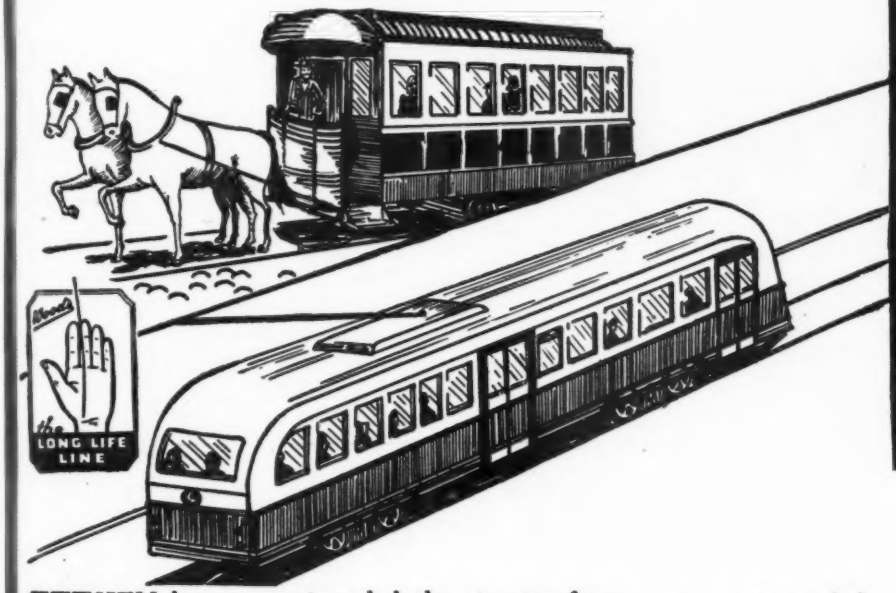

WHEN horse cars traveled the streets of our cities, Wood's line of power transmission was familiar equipment in shops and factories of those early years. In this modern age of streamlined trolleys and busses, Wood's products provide day-in and day-out *planned* transmission for modern industry.

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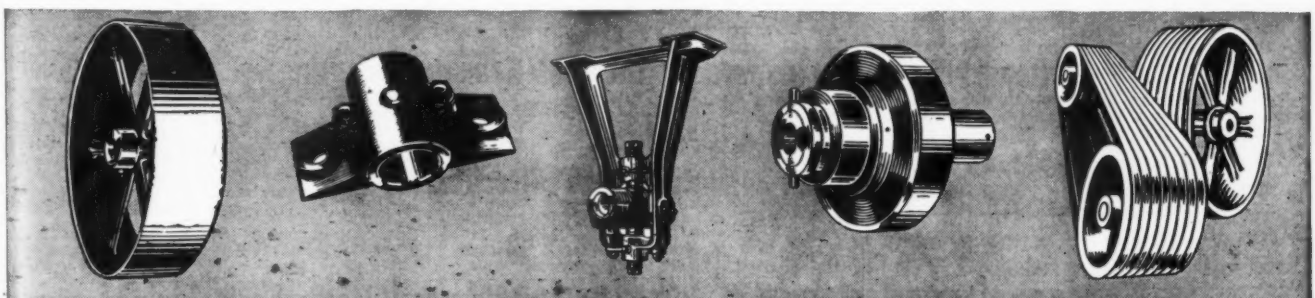

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Coming in Mid-December

POWER'S
SEVENTH ANNUAL

Buyer's Reference Number

including these features

1
Review of new power equipment, materials and supplies.

2
Report on power papers at the ASME annual meeting.

3
Review of manufacturers' literature.

4
Directory of manufacturers of power equipment, materials, supplies.

SEARCHLIGHT SECTION

POSITIONS VACANT

MECHANICAL ENGINEER familiar with steam power plant work for permanent position with midwest engineering firm as assistant to head of mechanical engineering section. Good opportunity. Give complete experience record and statement of availability. P-865, Power, 520 N. Michigan Ave., Chicago 11, Ill.

DESIGN ENGINEER—An unusual opportunity with large internationally known manufacturer of Air Conditioning and Refrigeration equipment for capable design engineer of refrigeration compressors and condensing units to work as assistant to chief. All replies will be confidential. Please outline qualifications. P-882, Power, 330 W. 42nd St., New York 18, N. Y.

RESEARCH ENGINEER—Unusual opportunity for capable engineer experienced in design and research work of air conditioning and refrigeration equipment to operate new modern laboratory for internationally known manufacturer of Air Conditioning and Refrigeration equipment. All replies will be confidential. Please give outline of qualifications. P-883, Power, 330 W. 42nd St., New York 18, N. Y.

WANTED—By an old line Instrument Manufacturer, a development engineer familiar with flow meter design and practice. Good post-war possibilities. P-893, Power, 330 W. 42nd St., New York 18, N. Y.

MECHANICAL ENGINEER wanted with experience in power plant and maintenance preferably with paper mill experience. Plant located in Ohio. P-894, Power, 330 W. 42nd St., New York 18, N. Y.

CIVIL OR Mechanical draftsman wanted. Must be experienced in plant layout and building design, preferably with paper mill experience. Plant located in Tennessee. P-895, Power, 330 W. 42nd St., New York 18, N. Y.

CHIEF DRAFTSMAN with mechanical design background. Experience with hydraulic machinery or pumps desirable. Permanent position with long established pump manufacturer. Salary open. Dean Brothers Pumps, Inc., Indianapolis 7, Indiana.

WANTED: POWER plant engineer and fireman. Small steam plant Central Illinois. Turbo-generators. Chain grate stokers. Good working conditions. P-896, Power, 520 N. Michigan Ave., Chicago 11, Ill.

Opportunities in Research

Unusual opportunities in the postwar period will be available at Battelle Memorial Institute for qualified research men now in the services or engaged in war research.

This endowed industrial and scientific research institution will add a selected number of competent scientists to its staff just as rapidly as they are relieved of their war responsibilities. The men chosen will be given every opportunity to develop in their professional fields and to apply their scientific knowledge to the solution of industrial problems.

Such men will find modern scientific tools available for their use in the well-equipped Battelle laboratories, and they will be aided by a comprehensive program of fundamental research designed to expand their knowledge and their ability. Batelle operates in an unusual atmosphere which has a strong appeal to the professional research man. Opportunities for further education, technical growth, and administrative responsibility exist.

Experienced research men in the fields of chemistry, chemical engineering, electrochemistry, physics, metallurgy, fuels, light metals, plastics, ceramics, mechanical engineering, design and product engineering, electrical engineering, applied mechanics, mining, raw materials, and allied technical professions will be considered.

Whatever your postwar plans may be, inquire now about these opportunities at Battelle. Write to:

BATTELLE MEMORIAL INSTITUTE
Columbus 1, Ohio

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. Postwar plans are creating lifetime opportunities now. This thoroughly organized confidential service of 35 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Several weeks are required to negotiate and each individual must finance the cost of his own campaign. Retaining fee protected by refund provision. Identity covered and present position protected. Plan now for post-war security. Send only name and address for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

MECHANICAL ENGINEER, now employed, excellent references, extensive executive power plant operating experience, good record in handling personnel, experienced in heat balances and effecting economies, desires position preferably with concern operating several power plants. PW-875, Power, 330 W. 42nd St., New York 18, N. Y.

POWER STATION Chemist and research engineer wishes job as chief chemist or research engineer in major company preferably connected with the power industry. Age 36, Ph.D. in chemistry, and 12 years' experience with major company in water problems, corrosion, lubrication and other oil problems. Considerable executive experience. PW-897, Power, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGR. Degree. Age 35. Desires permanent industrial connection as power or plant engr. Experience power plant construction operation, maintenance and testing. Reports. Engineering studies, plant layout, aircraft process equipment. PW-898, Power, 330 W. 42nd St., New York 18, N. Y.

GRADUATE MECHANICAL Engineer. 32 years of age, eleven years experience in maintenance and operation in a medium and large size central generating station. At present employed in responsible position as Efficiency Engineer in 125,000 kw. steam generating station of an eastern utility. Desires an opportunity in the power and steam generating field of the oil, chemical or synthetic rubber industry. PW-899, Power, 330 W. 42nd St., New York 18, N. Y.

SALESMEN WANTED

BRANCH OFFICE Manager for Chicago. This office has been established many years. Active accounts developed. Will allow substantial drawing account to applicant experienced in selling centrifugal pumps or steam turbines. Excellent opportunity for desirable permanent connection. Write fully concerning experience, education, etc. Replies strictly confidential. Dean Hill Pump Company, 4000 E. 16th St., Indianapolis 7, Indiana.

HOME OFFICE, steam turbine sales engineer. To take complete charge of sales. The position requires an engineer thoroughly familiar with turbines and their application, and experienced in making estimates and developing sales, both direct and through representatives. Man now in a junior position, and for lack of an opening is unable to advance, would find this a splendid opportunity to make permanent connection with an old established company. Give complete experience, history, education, age and salary expected. Replies strictly confidential. Dean Hill Pump Company, 4000 E. 16th St., Indianapolis 7, Indiana.

BUSINESS OPPORTUNITY

SALESMEN WITH trade acquaintance, make up to $100 per day selling surplus listings. Part—Full time. War Surplus Reporter, 20 East Jackson, Dept. 11, Chicago.

Bids: September 20, 1945

TURBINE GENERATOR SET

The A & M College of Texas, College Station, Texas invites bids F.O.B. College Station, Texas on one 375 KVA steam driven Westinghouse generator, impulsive type turbine 7245 RPM. Generator 60 cycles, 3 phase, 2400 volts, 900 RPM unit with 1000 sq. ft. condensor, circulating pumps, etc. Complete except switch board connections.

Unit is open to inspection any time.

Bids will be opened 2:00 PM in the office of the Business Manager September 20, 1945. The college reserves the right to reject any or all bids.

For details address B. D. Marburger, Superintendent of Utilities.

POWER ENGINEERS

Mechanical Engineers or Electrical Engineers, with aptitude and experience in heat balance thinking for work devoted to plant improvements, results engineering and effecting economy in the generation and consumption of steam, electricity, compressed air, water and refrigeration. Several openings for qualified men at different locations in the United States.

Give full experience, education, age, present salary and salary expected. Enclose snapshot.

Post-war opportunity.

Applicants must be able to obtain Statement of Availability.

E. I. du Pont de Nemours & Co., Inc.
Personnel Division
Wilmington 98, Delaware

WANTED

POWER ENGINEER

Graduate engineer with experience in industrial electrical applications.

Experience in design, construction and operation of power plants preferred.

Excellent permanent opportunity with large manufacturer maintaining a central engineering department which services all company plants.

War Manpower Commission regulations must be observed.

Write giving experience, age, draft status and salary requirements to

P-887, Power
330 West 42nd St., New York 18, N. Y.

WANTED

POWER ENGINEER

Mechanical or Electrical Engineer with experience in heat balance thinking for permanent position devoted to layout and design of plant improvements and expansion effecting efficient generation and usage of steam, electricity, refrigeration and utilities.

Reply giving brief data. Interview will be granted and negotiations in confidence.

P-900, Power
330 West 42nd St., New York 18, N. Y.

MECHANICAL DESIGNERS

Experienced in power, industrial, and processing plants. Location, New York City.

EBASCO SERVICES INC.
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What is *your* problem?

Competent men for your staff? . . . employment? . . . or are you looking for—or offering—a business opportunity of special interest to readers of this publication? You can get their attention—at small cost—through an advertisement in the Searchlight Section of Power.

The Austin Company

Invites Applications from Capable Engineers and Draftsmen

This invitation is not directed to men in urgent war work but rather to those who can consider more effective effort in the present execution of vital war plants under high priority ratings, and the opportunity to participate in an increasing amount of postwar private work.

To applicants who are ambitious, straight-thinking, and of sound education and training, this company offers positions with ample opportunity for advancement on the East Coast, Central West, Gulf Coast, or the West Coast.

Positions open are for experienced designers, draftsmen and recent college graduates qualifying in—

MECHANICAL

Industrial Plant Equipment * Process Piping * Power Plants * Heating Systems * Air Conditioning and Ventilation * Conveying Systems * Plumbing and Sewers * Sprinkler Systems * Precision Machine Design.

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Power Wiring A.C. and D.C. * Control Wiring * Industrial Illumination * Power Distribution * Electronic Applications * Radar * Controls.

National Headquarters

16112 EUCLID AVENUE — CLEVELAND — 12 — OHIO

WANTED

ASSISTANT TO CHIEF ENGINEER

To take complete charge of our Power Plant supervising the operation and maintenance of high pressure boilers, turbines, and auxiliary equipment. Young man with both technical and practical background preferred. Excellent opportunity for growth in responsibilities. Give complete personal and business history in letter of application.

FORT HOWARD PAPER CO.
Green Bay, Wisconsin

CHEMICAL ENGINEER

With extensive manufacturing experience desires contacts with leading manufacturers of materials and equipment, as west coast representative. Possess excellent technical and business record, and wide acquaintanceship with west coast industries.

RA-889, Power
68 Post Street, San Francisco 4, California

Direct Current Power Plant In Manhattan

110-volt, 2-wire, 1200-KW Capacity
125-lb. Steam Operating Pressure—Non-Condensing.

ENGINE-GENERATOR UNITS

2—277-KW, 120-volt D. C. Westinghouse Generator, direct connected to 18½" x 18" Phoenix Engine.

2—185-KW, 120-volt D. C. Westinghouse Generator, direct connected to 16" x 15" Phoenix Engines.

1—217-KW, 120-volt D. C. Burke Generator, direct connected to 14½" x 19" Ames Unaflow Engine.

1—433-KW, 120-volt D. C. Burke Generator, direct connected to 20" x 22" Erie Ball & Valve Engine.

Complete with generating switchboard having air circuit breaker disconnects, ammeters, voltmeters, rheostats and totalizing watt-hour meter.

Plant now in operation—may be inspected.

Price available to qualified prospective purchasers.

CITY INVESTING COMPANY
30 Broad Street, New York 4, N. Y.

STEAM TURBINE ENGINEERS

Now and Post War Wanted by Established New England turbine Mfg. Should have experience in calculation and design of Moderate-size steam turbines. State experience and salary expected. The Mfg's organization has been told of this opening.

P-890, Power
330 West 42nd St., New York 18, N. Y.

1—200 H.P. G.E. Slipring Motor, Type I Volts 2200 Phase 3 Cycle 60 RPM 600
1—150 H.P. G.E. Slipring Motor, Type I Volts 440 Phase 3 Cycle 60 RPM 720
1—100 H.P. G.E. Slipring Motor, Type I Volts 440 Phase 3 Cycle 60 RPM 1800
1—60 H.P. G.E. Slipring Motor Volts 440 Phase 3 RPM 865
1—100KW Westinghouse Generator Volts 220 Phase 3 Cycle 60 RPM 720 complete with exciter and switchboard

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1814-16 UNION AVENUE
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CUMMINS
2—100 K. W.
3/6/240
6 cyl—7x10—720 RPM
Rebuilt & Guaranteed

ROBERT SCHOONMAKER
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60,000 gal. capacity tank on 98' tower with 10" riser pipe

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"ANYTHING containing IRON or STEEL"

DRAFTSMEN WANTED

for both Centrifugal and reciprocating pump work. Permanent positions and desirable working conditions. Experience in pump work preferred but all applicants will be considered.

WARREN STEAM PUMP CO., Inc.
WARREN, MASS.

WANTED

Graduate Mechanical Engineer

With experience covering Studies, Reports and Design of Steam Power Plants, by established Engineering Firm.

P888, Power
330 West 42nd St., New York 18, N. Y.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

Buying Good Used Equipment

is frequently the difference between having needed equipment or doing without it.

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6 INDIVIDUAL HIGH PRESSURE POWER PLANTS!

(OPERATED BY THE GEORGIA POWER CO. *As Recently as December 1944*)

SALE TO BE HELD AT THE:

PIEDMONT HOTEL, ATLANTA, GA.

SALE DATE:

WEDNESDAY, SEPT. 26, 1945 AT 11 A. M.

Plants now open for inspection

COMPRISING

23 HIGH PRESSURE BOILERS FROM 25 HP TO 600 HP, Water Tube, Oil and Coal Fired, 150# to 200# pressure.

ENGINE GENERATOR SETS—ROTARY CONVERTERS—11 TURBO GENERATORS FROM 500 KW to 2750 KW—STEAM & MOTOR DRIVEN EXCITERS—ELECTRIC MOTORS from 2 to 125 HP—PUMPS—CIRCUIT BREAKERS—FEED WATER HEATERS—INSTRUMENTS—BLOWERS,—FANS— . . . and hundreds of other items too numerous to mention.

LOCATION OF PLANTS: 5 PLANTS LOCATED IN GEORGIA—at: Griffin, Athens, Americus, Augusta and Albany. 1 PLANT LOCATED AT: Langdale, Alabama.

INSPECTION: CONTACT MR. R. ROBBIN OR MR. D. CENTER at 349 Decatur St. S.E. ATLANTA, GA. TELE. NO. WALNUT 9412 or MAIN 4947. *PLANTS NOW OPEN FOR INSPECTION.*

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A single source for every type of POWER PLANT MACHINERY

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3125 KVA G.E. condensing, 225 lbs. pressure, 500° TT, 2300 volts, 3600 RPM equipped with either a surface or jet condenser, switchboard and instruments.

1875 KVA G.E. condensing, 175-200 lbs. pressure, 500° TT, 6600 volts, 3600 RPM complete with condenser.

1250 KVA Westinghouse non-condensing, 200-250 lbs. pressure, 500° TT, 15 lbs. gauge back pressure, 480 volts, 3600 RPM complete with exciter, switchboard panel and instruments.

1250 KVA Elliott condensing, 175-300 lbs. pressure, 240 volts, 3600 RPM complete with jet condenser and auxiliaries.

937 KVA G.E. condensing, 150-175 lbs. pressure, 2300 volts, 3600 RPM complete with direct connected shaft exciter, surface condenser and auxiliaries.

780 KVA Westinghouse non-condensing, 175-200 lbs. pressure, 15 lbs. back pressure, 480 volts, 3600 RPM complete with switchboard.

625 KVA G.E. non-condensing, 210-250 lbs. pressure, 600° TT, 15 lbs. gauge back pressure.

375 KVA G.E. condensing, 150-200 lbs. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

125 KVA Westinghouse non-condensing, 175-200 lbs. pressure, 0-10 lbs. gauge back, 240 volts, complete with direct connected exciter and switchboard.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle Alternating Current

900 KVA Allis-Chalmers, 480 volts, 150 RPM generator direct connected to 24" x 36" Filer Stowell semi-Unaflow engine.

500 KVA Westinghouse, 460 volts, 164 RPM generator direct connected to 26" x 28" Skinner Unaflow non-condensing engine, 140-160 lbs. pressure, 0 to 10 lbs. gauge back pressure. Complete Installation.

375 KVA G.E. 240 volts, 200 RPM generator direct connected to 22" x 24" Skinner Unaflow non-condensing engine, 150-175 lbs. pressure, 5 lbs. gauge back pressure.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator direct connected to 17" x 24" Elliott Unaflow non-condensing engine, 175 lbs. pressure, 6 lbs. gauge back pressure.

312 KVA Westinghouse 240/480 volts, 200 RPM generator direct connected to Skinner Unaflow non-condensing engine.

200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames vertical Unaflow engine, 110-125 lbs. pressure, 5 lbs. gauge back pressure.

188 KVA Crocker-Wheeler, 208/120 volts, 225 RPM generator direct connected to 17" x 18" Skinner counterflow engine, 135 lbs. pressure, 5 lbs. gauge back pressure. Complete Installation.

156 KVA G.E. 240 volts, 225 RPM generator direct connected to Nordberg Unaflow engine.

125 KVA G.E. 240 volts, 257 RPM generator direct connected to 17" x 16" Skinner Unaflow engine, 100-130 lbs. pressure, 5 lbs. gauge back pressure.

93.8 KVA G.E. 240 volts, 257 RPM generator direct connected to 13" x 15" Skinner Counterflow engine, 100-130 lbs. pressure, 5 lbs. gauge back pressure.

ENGINE-GENERATOR UNITS

Direct Current

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to Ames vertical Unaflow non-condensing engine.

125 KW Elliott, 125 volts, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lbs. pressure, 10 lbs. back pressure, complete with switchboard.

75 KW Westinghouse, 125 volt, 1800 RPM non-condensing turbine-generator unit.

75 KW Allis-Chalmers Terry, 125 volt, 2400 RPM non-condensing turbine-generator unit.

15 KW (3) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to American Blower vertical engine.

SPECIAL OFFERINGS

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

1690 C.F.M. 110 lbs. air pressure Ingersoll-Rand steam driven air compressor 125-150 lbs. steam pressure.

750 KVA Westinghouse 3 phase, 60 cycle, 2300 volt alternating current generator direct connected to 910 HP, 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

1200 KVA G.E. 3 phase, 60 cycle, 2400 volts alternating current generator direct connected to 1700 HP 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

750 HP Babcock & Wilcox Sterling water tube boiler ASME National code, 225 lbs. pressure, complete with stoker.

528 HP Heine water tube boiler ASME code, 200-300 lbs. pressure, less stoker.

407 HP (3) Wickes water tube boilers, ASME code, 150 lbs. pressure, complete with stokers.

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CLEVELAND 14, OHIO

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LONG DISTANCE 422

WHY USERS LIKE HEMPHILL QUALITY EQUIPMENT

"That Generator from Hemphill runs like she was FACTORY-NEW!"

Yes sir—the standards of performance established for rebuilt equipment by Hemphill Graduate Electrical Engineers are as high as the original maker of power equipment. The Hemphill rebuilding shops, staffed by experienced workmen, are under the supervision of our Electrical Engineers, who decide what rebuilding is needed and check finished test performances.

The Hemphill SEAL OF QUALITY GUARANTEES ENGINEERED RECONDITIONING

MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM, Lincoln, 440 volt, slip ring.
1—400 HP, 1200 RPM, 220 volt, Westinghouse squirrel cage.
1—350 HP, 300 RPM, 440 volt, General Electric slip ring.
1—225 H.P. 1200 RPM, 220 volt, General Electric, squirrel cage.
1—200 HP, 600 RPM, 2300 volt, G.E. sl. rg.
1—150 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
1—150 HP, 400 RPM, 440 volt, General Electric squirrel cage.
1—125 HP, 1800 RPM, 2300 volt, Continental, squirrel cage.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
3—100 HP, 450 RPM, 440 volt G.E., sq. cg.
1— 90 HP, RPM, 550 volt, Cr. Whir., sq. cg.
1— 75 HP, 720 RPM, 440 volt, Westghse, slip ring.
1— 75 HP, 1200 RPM, G.E., sl. rg.
1— 60 HP, 1200 RPM, 220 volt, General Electric, slip ring.
1— 50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1— 50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D. C. 230 VOLTS

3—450 HP, G.E., 440 RPM, Type MPL Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—125 HP, 1170 RPM, G.E.
1—100 HP, 625 RPM, G.E.
1— 80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1— 75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.

MOTORS—D.C. 230 VOLTS (Con't.)

1—50 HP, 700 RPM, Crocker-Wheeler.
1—30 HP, 750 RPM, G.E., Type BC.
1—30 HP, G.E., 750 RPM, Type BC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type BC-31B, Form A-31.
1—35 HP, G.E., 650 RPM, Type BC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type BC-13.
1—20 HP, G.E., 800 RPM, Type BC-13, Form A.
1—15 HP, G.E., 800 RPM, Type BC-11.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—60 HP, 500/1000 RPM, Diehl.
1—30 HP, 225/900 RPM, Crocker-Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
1—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—15 HP, 300/1200 RPM, G.E.
1—18/18 HP, 350/1200 RPM, Electro Dynamic.
3—11¼ HP, 500/1500 RPM, Westinghouse.
1— 5 HP, 600/1200 RPM, General Electric.
1— 5 HP, 450/1800 RPM, Crocker Wheeler.
1— 5 HP, 400/1600 RPM, Diehl.
1— 5 HP, 225/900 RPM, Electro Dynamic.

MOTOR GENERATOR SETS

1—150 KW, 125 volt, Westinghouse, squirrel cage.
1— 75 KW, 125 volt, General Electric, squirrel cage.
1— 65 KW, 125 volt, Westinghouse, squirrel cage.
1— 20 KW, 600 volt, General Electric, squirrel cage induction motor.
2— 15 KW, 250 volt, General Electric, squirrel cage.

TURBO GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—375 KVA, Westghse., non-condensing.
1—300 KW. 125/250 General Electric non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v. con.
1—200 KW, G.E., 3 ph., 60 cy., 220 v. cond.
1— 30 KW, 135 volt, Allis Chalmers non-condenser.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 2300 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis-Chal.
1—150 KVA 900 RPM 2300 volt, G. E.
1—62½ KVA, 3600 RPM, 220 volt, Allis-Chal.

TRANSFORMERS

2—400 KVA, G.E., 4156-250/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—150 KVA, G.E., 33000/2300/4000 Y.
2—100 KVA, General Electric 2200/220/440 volt.
3—100 KVA, Westinghouse, 11,430/250 volts.
3—100 KVA, Westinghouse, 13200/250 volts.
3— 75 KVA, Westinghouse, 2200/220/110 volts.
3— 75 KVA, G.E., 13,500-750/440 volts.
1— 75 KVA, G.E., 3 phase, 4156Y—120/208Y.
2— 50 KVA, Pbgh., 7500/15000 volts-110/220 volts.
2— 15 KVA, G.E., 2300-115/230 volts.
2—100 KVA, G.E., 2400/240/480.

GASOLINE DRIVEN D.C. GENERATOR SETS

2—25 KW, 125 volt.
1—30 KW, 125 volt.
1—120 K.W. A.C. 240 volt, 3 phase.

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Rebuilt and Sold with a Standard New Guarantee

ONLY PARTIAL LIST

TRANSFORMERS

1—200 KVA GE, type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—200 KVA GE, type H Form VD 4800/2400/480 volts, 1 PH. 25 cy.
1—100 KVA GE, type H Form KDD 11000/2600 volt, 1 PH, 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
3—75 KVA Gen. Elect. K.S. 1 ph. 60 cy. 2300/115/230 volts.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle, 3 phase, 450 R.P.M. with direct connected exciter.
200 KW, Westh. Unity Power Factor, 3 PH, 60 cyc. 220/440 900 R.P.M. with direct connected exciter
150 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts, 600 R.P.M. Revolving field with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 with Rev. Field. and built in Exc.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.

FREQUENCY CHANGERS

30 KVA, Gen. Elect. type I.T.T. frame 526 P.F. 08—220/440 volts 3 Ph. 60 cy. to 240 volts 120 cycle Motor KT frame 526—3 Ph. 60 cy. 220/440 volts 1200 RPM.

ALL SIZES VOLTAGES AND CYCLES

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volt
350	Gen. Elec.	Sl. Rg. 3 Brg	I	375	400
250	Gen. Elec.	S. R.	I. M.	500	440
200	Lincoln	S. R.	I. X. W.	500	400
100	West.	Syn. Stator and Rotor	H. R.	300	2200
100	Wagner	Sl. Rg.	BR	750	220/440
70	Gen. Elec.	Syn. Stator and Rotor	ATI	167	2200

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
200	West.	Syn.-Dir. Con. Ex.	P. F. 08	900	220/440
200	Gen. Elec.	Syn.	ATI	514	4000/2300
200	Weghse.	Syn.	Dir. Con. Exc.	600	2300
150	Gen. Elec.	Syn. Stator and Rotor	ATI	400	2200
25	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

230 Volt D. C. Motors

H.P.	Make	Type	Speed
75	Crocker Wh.	CCM25JA	700
60	Sprague	D — Comp. Wound	625
40	Fair. Morse	Ball BRG. Vert. Comp.	1740

125 Volt D. C. Motors

H.P.	Make	Type	Speed
60	Allis Chalmers	FB131-Comp. V. B. Pipe Vent.	1755

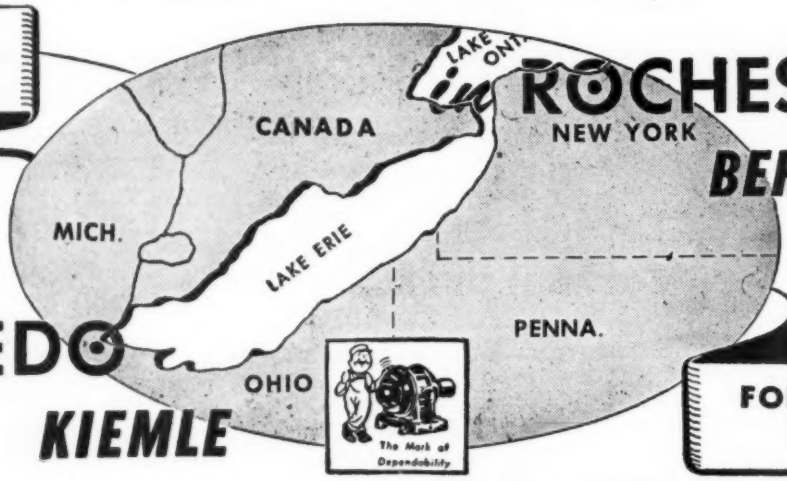
550 Volt D. C. Motors

H.P.	Make	Type	Speed
35	West.	Sk 150 Shunt Int.	850

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V. 600 R.P.M.
50 KW—Northern—Comp. 110 V.—700 R.P.M.

OVER 10,000 STOCK ITEMS



THE FRED W.
KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO 4 OHIO

BERGER BROTHERS
ELECTRIC MOTORS, Inc
395 STATE ST.
ROCHESTER 4
NEW YORK

FOR IMMEDIATE DELIVERY

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300 1 phase 25 cycle.
1—350 KVA, GE, type H-K.D.D. 2300/460—1 PH, 60 Cy.
3— 50 KVA Pittsburgh 60 cycle, 1 Ph, 440/110/220 Volts.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

10 K.W. Gen. Elect. 1 Ph. 60 Cy. 2200 Volts—1800 R.P.M.

WEST. D.C.—VARIABLE SPEED MOTORS

10—10 H.P. Type S.K. 230 V. 500/1500 R.P.M. with Automatic Dynamic Braking Starters and Field Rheos.

SYNCHRONOUS—CONVERTER

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed with transformers for 2300 volts to 230 volts D.C.

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
500	Electric Mach.	Syn.	Stator and Rotor	257	440
200	Weghse.	Sl. Rg.	CW	600	220/440
150	Gen. Elec.	S. R.	I. M.	400	440
100	Lincoln		M	1150	440
100	Allis. Ch.	S. R.	A. N. Y.	600	440

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volts
150	Gen. Elec.	S. R.	IM	500	440
100	Allis Ch.	S. R.		750	440
75	Gen. Elec.	Var.	BTA	375/750	440
75	Gen. Elec.	S. R.	I. M. 17B	160	440
75	Gen. Elec.	Sl. Rg.	I. M.	760	220/440

230 Volt D. C. Motors

H.P.	Make	Type	Speed
150	West.	SK 180L Comp. Wd. Int.	1150
100	Northwestern	K30 Comp. Inter.	1750
60	Gen. Elec.	C-Shunt Wd	600
50	Crocker Wheeler	CM	625

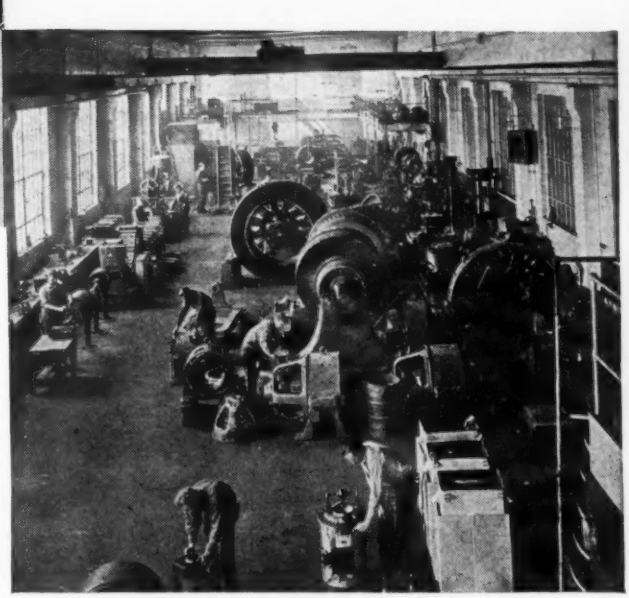
Rebuilt and Sold with a Standard New Guarantee

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

Above KIEMLE OFFERS

You've heard about **BELYEA RE-NU-BILT**

Here's a view of the shop that backs our reputation



The facilities and layout of our plant are designed for THOROUGHNESS in rebuilding electrical power equipment in all sizes, from the largest and heaviest to those in our small motor department.

The rebuilding tolerances of all RE-NU-BILT equipment are in accordance with the adopted "Rebuilding Standards of NISA." (Copy of Standards furnished on request.) The Belyea one year guarantee is backed by our 37-year reputation for reliability.

Here's what BELYEA offers today—only partial Stock Listing

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1500 KW G.E. 250/275 V. D.C. to 2100 H.P., 2300 V.
1—500 KVA—300 KW—220/440 V. A.C. Gen. to 500 H.P.—230 V. D.C. Motor.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.
1—300 KW Whse. 275 V. D.C. to 450 H.P. 4000/6600 V. with exciter.
1—288 KVA Whse., 440 V. A.C. Gen. DC to 304 H.P. —115 V. DC Motor.
1—240 KW Whse., 125 V. DC Gen. DC to 360 HP —440 V.
1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.
1—50 KW G.E., CD 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.
1—46 KW Al. Ch. Balancing Set 125/250 V.
1—45 KW Whse. 250 V. D.C. to 75 H.P. 440 V. Sq. Cg.
1—25 KW GE 250 V. D.C. to 40 HP KT Sq. Cg. 220/440 Volt.

3 Phase 25 Cycle

1—25 KW G.E., 125 V. D.C. to 35 H.P., 360 V. Motor.
1—75 KW Whse., 125 V. D.C. to 110 H.P., 440 V. Motor.
1—250 KW G.E., 250 V. D.C. to 285 KVA, 6600 V. Motor.

TRANSFORMERS—POWER AND DISTRIBUTION

60 CYCLE (Unless Otherwise Noted)

Qu.	KVA	Make	Ph.	Type	Voltages
3	1667	Pitts.	1	OISC	13200x2300
1	1050	G.E.	3	WCTH	11000x445/222½
4	525	G.E.	1	HJ	2300x445
2	450	G.E.	3	HTDD	6600x240
4	500	Pitts.	1	OISC	13200x2300
2	333	Pitts.	1	OISC	2400x220
3	333	Maloney	1	C	22000/11000x2300/575
2	333	Whse.	1	OISC	2300/460
1	300	Pitts.	3	OISC	4150x208/120
3	200	G.E.	1	HLLD	27600x115/460
2	200	G.E.	1	HKDD	13800x220/440
1	200	Whse.	1	SK	6600x220/440
3	200	G.E.	1	HJ	2300x408/204
1	200	G.E.	2–3	Auto	2500x2500
1	200	G.E.	1	H	2300x115x230
3	150	Maloney	1	C	2300x220/440
2	125	Maloney	1	C	2300x220/440
3	100	G.E.	1	HJDD	13200x445/226
3	160	Whse.	1	OISC	13200x250
1	100	Whse.	1	OISC	11430x250
2	100	G.E.	1	A	2200x120/240

A.C. MOTORS

3 Phase 60 Cycle

SLIP RING

Qu.	HP	Make	Volts	RPM	Desc.
1	100	G.E.	440	575	IM
1	100	G.E.	550	685	MTC-5552
1	100	G.E.	550	720	IM
1	100	G.E.	2200	1750	IM
1	100	G.E.	220	1750	IM
1	200	G.E.	440	450	IM (3 Brg.)
1	200	Whse.	440	580	CW
1	200	Al. Ch.	440	505	
1	250	G.E.	4000	257	MT-424Y
1	250	Al. Ch.	440	505	ANY
1	350	G.E.	4000/2200	253	MT-442Y
1	350	G.E.	550	390	MT-412Y
1	400	G.E.	2200	252	IP
1	400	A.-C.	2300	5505	ANY
1	450	Whse.	2200	875	CW
1	500	Al. Ch.	2200	590	ANY-36
1	600	Cr. Wh.	2200	507	131-AQ
1	800	A.-C.	400	885	ANY
1	1200	C.W.	2300	237	801Q
1	2500	G.E.	6600	253	MT

SQUIRREL CAGE

Qu.	HP	Make	Volts	RPM	Desc.
1	150	Whse.	440	400	CS-594A
2	175/112	G.E.	440	990/720	IK
1	200	G.E.	440	580	IK
2	200	G.E.	2300	1175	IK
1	200	G.E.	2200	490	IK
1	200	G.E.	550	580	IK
1	300	G.E.	440	900	IK
1	300	Whse.	550	580	CS

SYNCHRONOUS

Qu.	HP	Make	Volts	RPM	Desc.
1	75	G.E.	220	600	TS 7556
1	600	Al. Ch.	2300	720	
2	2100	G.E.	2200/4400	514	ATI

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed	Desc.
1	750	G.E.	220/440	900	ATI
1	2000	Whse.	2300	720	
2	2100	G.E.	2300/4600	514	ATI
1	3000	Al. Ch.	2300	900	
1	5000	Whse.	2300/4000	900	

3 Phase 25 Cycle

1	75	Al. Ch.	440	750	ANY
1	150	G.E.	440	500	IM
1	200	G.E.	440	242	Sl. Rg.
1	300	G.E.	440	290	Sl. Rg.
1	390	G.E.	6600	750	ATI
1	1400	G.E.	2300	500	ATI

ROTARY CONVERTERS

3 Phase 60 Cycle

Qu.	KW	Make	Speed	Dc V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	Whse.	720	250	22000
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
2	300	G.E.	1200	600	2300
1	300	Al. Ch.	1200	250	2400

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500/225/275/13200/6600
1	500	G.E.	750/225/275/13200/6600

All units can be furnished with AC and DC controls

D.C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	180
1	1200	G.E.	MPC	600	450
1	800	G.E.	MPC	550	600
2	625	G.E.	MPC	500	130
1	500	G.E.	MPC	230	900
1	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	Al. Ch.		230	525
1	200	Whse.	SK	230	400
3	135/175	G.E.	MCF	230	450/1050
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625
1	100/150	Whse.	SK-200	550	600
1	100	G.E.	LC-50	230	1200
1	100	Whse.	SK-180	230	600
1	50/100	G.E.	MPC	230	225/450
1	75	G.E.	C	230	500/1000
1	60	El. Dy.	258	230	525/1050
1	50/60	Cr. Wh.	CMC-65H	230	500/1000
1	50	Cr. Wh.	CMC-80H	230	380/750
1	15/50	Cr. Wh.	CMC-81H	230	300/900
2	40	El. Dy.	305	230	300/900
1	40	G.E.	CD-123	230	500/1500
1	35	Rel.	310T	230	400/1600
1	35	G.E.	RF-14	230	400/1600
3	25/30	G.E. (new)	CD-1136S	230	400/1600
17	30	Whse.	SA	230	500/1500
2	16/25	Cr. Wh.	CMC-355A	230	400/1200
1	25	Whse.	SK-150	230	300/1200

SUCCESSFUL OPERATION GUARANTEED

Quality without Question

BELYEA CO., INC.

Main Office and Shop

43 HOWELL ST., JERSEY CITY, N. J.

RE NU BILT BELYEA MOTORS

DEPENDABLE ELECTRICAL EQUIPMENT

Guarantee — Rebuilt equipment in accordance with specifications as quoted is sold by us completely and thoroughly shop reconditioned, tested and guaranteed for a period of one year from date of shipment, when operated under normal load, usage and conditions with proper care and competent supervision. Any mechanical or electrical parts proving defective under normal operation will be repaired or replaced (at our option) by us, f.o.b. our plant, New York, N. Y. We are not responsible for consequential losses or damages outside of this equipment nor for repairs or replacements made by others without our written authorization. Correction of defects by repairing or replacing by us shall constitute fulfillment of all our obligation to the purchaser.

1 YEAR!

SQUIRREL CAGE MOTORS
3 ph. 60 Cy.

Qu.	HP	Make	Type	Speed
1	200	G.E. 440 v.	IK	600
1	147	West 25 cy.	CS	715
1	100	Al. Ch.		690
2	100	G.E. 440 v.	PTA56	375/750
1	85	G.E. 2300 v.	PT529	3600
1	75	Burke		1150
1	50	Star	A75	1750
1	50	West.	CCL	1150
1	50	Al. Ch.		865
1	50	Cr. Wh.		865
1	50	Burke		690
1	50	West.	CS	580
2	45	W.E.		150/900
1	40	West.	CS	1760
1	40	G.E.	KT	1150
1	40	Lincoln		1150
1	35	Wagner		850
1	35	West.	CS	690
1	30	U. S. Vert.	CPU907	3450
1	30	A-C		1150
1	30	Diehl		860
1	30	Cr. Wh.		870
1	30	Al. Ch.		870
1	30	G.E.	KT342	690
1	30	West.	CCL	699
1	30	G.E.	IK	514
1	25	Triumph		1750
1	25	G.E.	KT303	1750
1	25	Wagner 220v.	F-W	1200
1	25	Al. Ch.		1150
1	25	West.	CS	1150
1	25	El. Dy.	KMQ444	865
2	25	G.E.	IK	865
2	25	Diehl	IS167	865
1	25	West.	MS	860
1	25	Wagner 440v.	F-W	720
128/12½		G.E.	445	840/405
1	20	West.	CS365	3500
1	20	G.E.	KT312	1740
1	20	G.E. Vert.	PT501	1750
2	20	El. Dy.	KNX364	1750
1	20	F.M.	KMV12D	1150
2	20	G.E. Vert.	KT513	1150
1	20	Cr. Wh.		1150
1	20	F.&M.		1160
2	20	West.	CS	1160
1	20	G.E.	KT332	1160
2	20	Al. Ch.		860
1	20	F.M.		860
1	20	Diehl		860
1	20	West.	CS566	870
1	20	G.E.	KT326	870
1	20	G.E.	IK	690
1	20	West.	CS584	690
1	20	West.	CCL	690
1	15	Burke		1750
1	15	Wagner 220v.	P-W	1800
21	15	El. Dy.	326	1750
1	15	Lincoln		1150
1	15	G.E. Vert.	KT502	1150
1	15	West.	CCL	1150
3	15	West.	MS	1150
1	15	West.	CS	1150
1	15	G.E. Vert.	IK	860
1	15	West.	CS	860
1	15	Wagner 440v.	F-W	720
1	15	G.E.	IK	720
1	15	West.	CS504	415
3	10	G.E.	KT	3600
1	10	Cr. Wh.	Gr.Hd.	400
12	15	West.	CS 445	600/900 1200/1800

SQUIRREL CAGE MOTORS
2 ph. 60 cy. type

Qu.	HP	Make	Type	Speed
1	100	West.	CS663C	1750
1	75	G.E.	IQ	1750
1	70	G.E. Synch.	AQI	1200
1	50	Lincoln		870
1	50	G.E.	IQ	870
1	40	Al. Ch.		870
1	40	F-M		870
1	35	Al. Ch.		870
1	30	West.	CCL	1150
1	25	G.E.	KQ513	1750
2	25	G.E.	ICL	1150
1	25	West.	CCL	1150
1	25	Burke		900
1	20	West.	CS	1160
1	15	F-M		1750
1	15	G.E.	KQ502	1150
1	15	West.	CS4	1150
1	15	G.E.	IQ	720

SLIP RING MOTORS
2 & 3 ph. 60 cy.

Qu.	HP	Make	Type	Speed
1	450	G.E.	MT412	506
1	250	G.E.	IM	580
1	150	El. Dy.	New	1770
1	100	G.E.	MTC5546	600
1	100	G.E.	IM	900
1	100	G.E.	IM	690
1	100	F-M	FA	690
1	75	West.	HF	1160
1	75	Al. Ch.		865
1	75	Al. Ch.	ANY	575
1	65	G.E.	MTC553	585
1	60	West.	CW648	1150
1	60	West.	CW950A	290
1	50	G.E.		870
1	40	Wagner		1150
1	40	F-M		870
1	40	West.	CWI	870
1	40	G.E.	MT312	870
1	35	Burke		690
1	30	G.E.	MC332	870
2	30	G.E. 2200v.	MT542	690
1	25	West.	CW	1160
1	25	Louis Allis		1750
2	25	Al. Ch.	ANY20G	870
1	25	Burke	FMV3	870
1	25	Howell	BF8420	870
2	15	G.E.	MT502	1150
1	15	West.	CW	870
1	15	Cleveland	MW147	870

A. C. GENERATORS

Qu.	Kw	Make	Voltage	Speed
1	150	G.E.	220/440	600
1	150	Cr. Wh.	220/440	900
1	100	West.	220/440	600
1	35	Allen	220/440	900
1	35	Burke	220/440	720
1	50	Elec. Mchy.	220/440	900
1	25	West. 1 ph.	110/220	1200

A.C. TURBO GENERATOR

625 KVA Westinghouse Geared Turbine, 150 lbs., 35 lbs. back pressure 3 ph. 60 cy. 2400 Volt .8PF also driving

D.C. MOTOR GEN. SETS

2—300KW Burke 3 wire 250/125 Volt. D.C. 900 RPM, 3 ph., 60 cycle, 4150 Volts Synchronous, Factory Built.

1—250KW General Electric, 125 Volt Direct Current, 720 RPM.

230 V. D.C. MOTORS

Qu.	HP	Make	Type	Speed
1	350	West.	SK	340/425
1	150	West.	S	600
1	60	G.E.	LC	450/1160
1	60	El. Dy.	288	450/900
1	50	El. Dy.		900
1	50	West.	SK150	550/1100
1	45	Diehl		850
1	40	G.E.	DLC	1050
1	40	Cr. Wh.	CCM	915
1	35	West.	SK	1150
1	35	West.	SK120	975
1	35	G.E.	DLC204	440/880
2	35	West.	SK160	400/600
2	30	G.E.	CD83	3450
1	30	G.E.	RC	1150
1	30	West.	SA	975
1	25	G.E.	RC	1150
1	25	West.	SK	1150
1	25	Diehl	K8	850
1	25	Louis Allis	Encl.	900
1	25	Al. Ch.		850
1	25	El. Dy.		1500
1	25	G.E.	CD113	575
1	20	G.E.	CD83	1200/1600
1	20	R. & M.		1150
1	20	G.E.	RC	1150
1	20	El. Dy.		950
1	20	G.E.	RC	800
1	20	West.	SK110L	750
1	15	Roch.	SV5	3450
3	15	G.E.	RC	1150
2	15	G.E.	CD	1150
1	15	G.E. Vert.	CD	900
1	15	West.	SK	850
1	15	G.E.	RC	850
1	15	West.	SK	600/2500
1	15	Diehl		200/247
1	10	G.E.	RF	450/1800
1	10	G.E.	CD	1150
1	10	West.	SK	400/1200
3	10	G.E.	RC	850
1	10	G.E.	CVC	700
1	10	Diehl		750
1	10	West.	SK	600/1200
1	10	El. Dy.		450/1800
1	10	G.E.	RF	400/1600
2	10	West.	SA	400/1200
1	10	G.E.	RF	450/1800
1	8½	Diehl		900
1	8½	West.	SK	850
1	8½	West.	SK90	350/1400
1	8	G.E.	RLC	500/1500
1	7½	G.E.	RC	1700
1	7½	G.E.	CVC	1525
1	7½	West.	SK	1450
3	7½	G.E.	RC	1150
2	7½	G.E.	RC	1150
1	7½	West.	SK	950
1	7½	Al. Ch.		850
1	7½	G.E.	RC	850
3	7½	G.E.	RF	600/1800
1	7½	El. Dy.		550/1650
1	7½	Watson		525/1150
2	7½	G.E.	RF	450/1800
1	7½	West.	SK	450/1600
1	7½	Al. Ch.		350/1050
1	3	West.	Gr. Hd.	12½

110 V. D.C. Motors

Qu.	HP	Make	Type	Speed
1	90	G.E.	DLC65	900
1	20	EK	RC	1150
1	15	Eck.		1000
1	15	El. Dy.		615/1230
1	10	El. Dy.	36	1100
1	10	West.	SK	850
1	10	El. Dy.	718	428/1275
1	10	Diehl		230
1	7½	Cr. Wh.		900
1	7½	West.	SK	500
1	7½	El. Dy.	58	450/900
2	7½	El. Dy.	58	600/1200

D.C. GENERATORS

KW	Make	Volts	Amps	Speed
300	West.	250	1200	900
250	G.E.	125	2000	720
100	West.	250	400	720
100	Al. Ch.	250	400	870
100	G.E.	125	800	1150
50	G.E.	250	200	870
50	G.E.	125	400	1150
40	El. Dy.	250	160	1150
30	Reliance	250	120	1750
30	West.	125	240	1150
30	El. Dy.	600	50	1150
25	West.	125	200	1150
25	El. Mchy. Syn.	125	200	1200
25	G.E.	250	100	1150
20	G.E.	125	160	1150
20	West.	250	80	1150
15	Burke	125	120	900
10	G.E.	250	40	1150
10	Al. Ch.	125	80	1150
10	G.E.	250	40	1150
7½	West.	250	30	1150
7½	G.E.	125	60	1150
5	G.E.	250	20	1150
5	West.	125	40	1150
5	G.E.	600	8	1750

D.C. TO A.C. GENERATORS

1—4 KVA Hertner, 115 v. DC to 115 v. 60 cy. 1 phase

1—7½ KVA Century 115 v. DC to 115 v. 60 cy. 1 phase

ELECTRONIC Speed Regulated Motor Drive

300 KW West. SK 250 Volt D.C. Generator 900 RPM. with 350 HP West. SK 250 V. D.C. Motor, double end shaft, speed 0 to 600 RPM. Complete with Pilot Generator, all control and necessary 4 unit Motor Generator exciters.

COOLANT PUMPS

50—New Ruthman (Gusher) Coolant pumps, with ¼ H.P. 3 ph. 60 cy. 220/440 Volt Motors.

800 & 400 Cycle Generators

3—1 KVA Holzer Cabot 3 ph. 60 cy. 220/440 V.

2—1 KVA—800 cycle.

THIS IS A PARTIAL LIST ONLY!

NEW YORK CITY'S LARGEST STOCK OF ELECTRICAL MACHINERY

L. J. LAND & COMPANY ESTABLISHED 1910

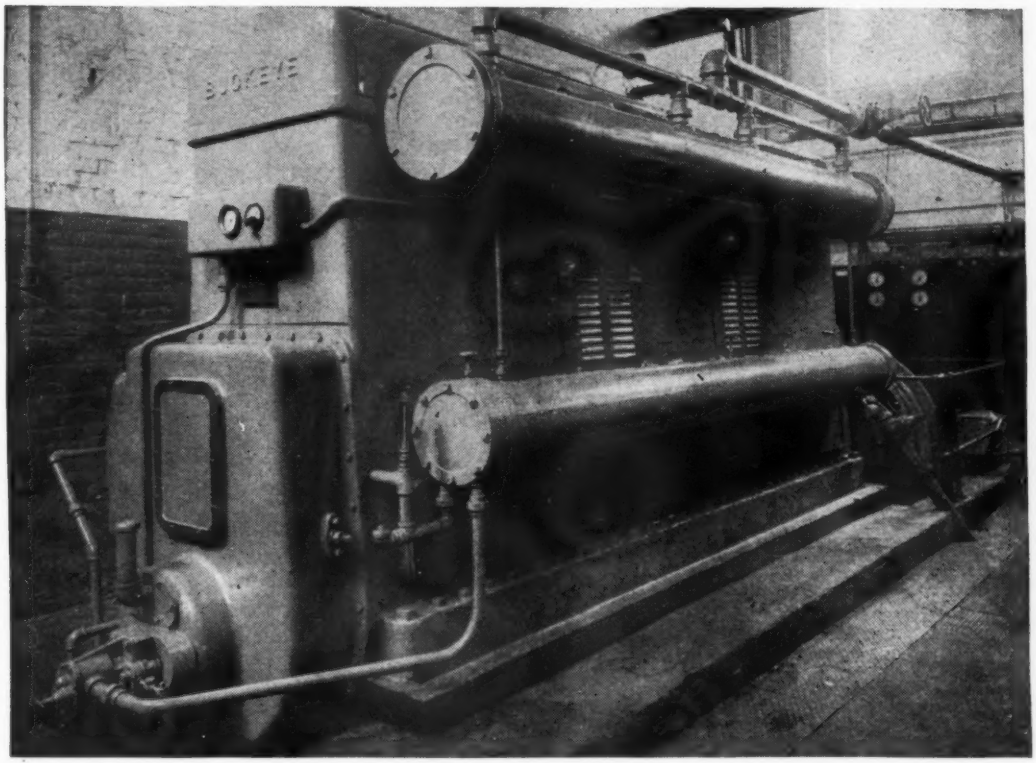
146 GRAND ST., NEW YORK 13, N. Y. CAnal 6-6976

Branch Offices:
10th & Exeter Streets, Reading, Penna.

BUCKEYE DIESELS

ALWAYS "TOPS" IN YOUR INDUSTRY

IMMEDIATE DELIVERY ON SEVERAL



REBUILT AND GUARANTEED

This unusual offering includes eight modern units each either direct connected to an alternating current generator or arranged for combination V belt and generator drive. Complete engine auxiliaries including starting equipment, lube oil filters, fuel transfer pumps, water and oil circulating pumps, fuel oil day tanks, lube oil sump tanks. Silent watchmen, foundation blue prints, and spare parts. Specifications are as follows:

1—290 HP Model 70—6 cyl. 10 x 12 — 514 RPM D. C. to 250 KVA — 1941
1—240 HP Model P —4 cyl. 10 x 12 — 514 RPM D. C. to 150 KVA — 1940
1—262 HP Model E —7 cyl. 9½ x 14 — 400 RPM D. C. to 175 KVA — 1938
1—225 HP Model E —6 cyl. 9½ x 14 — 400 RPM D. C. to 187 KVA — 1941
1—187 HP Model E —5 cyl. 9½ x 14 — 400 RPM D. C. to 156 KVA — 1938
1—150 HP Model E —4 cyl. 9½ x 14 — 400 RPM D. C. to 125 KVA — 1938
1—240 HP Model P —3 cyl. 13½ x 18 — 300 RPM D. C. to 187 KVA — 1932

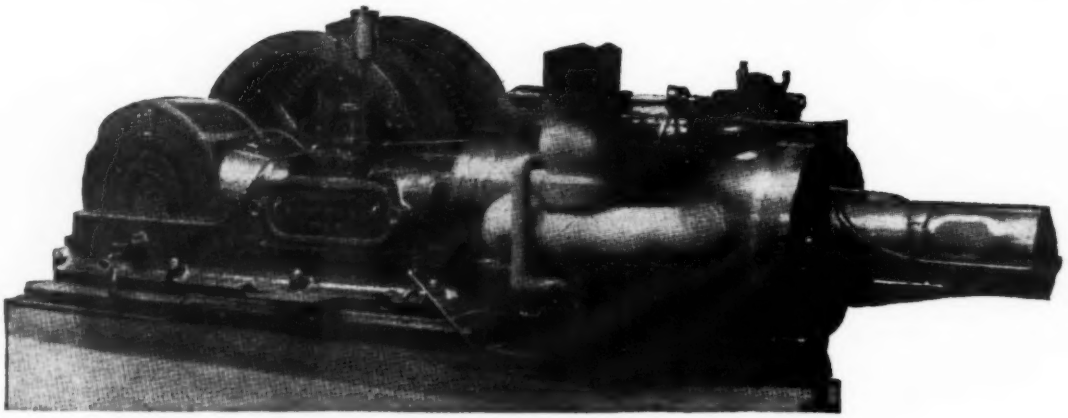
Running Inspection by Appointment.

ROBERT SCHOONMAKER

Port Washington, Long Island, N.Y.

Phone Roslyn 1220

POWER PLANT MACHINERY



312 KVA Skinner Uniflow Unit

250 KW 80% P.F. 312 KVA General Electric alternating current generator 3 phase 60 cycle 240/480/600/2300 volts direct connected 22"x24" Skinner Universal uniflow engine, side crank, right-hand, 125-175# steam pressure, 0-12# back pressure, 200 RPM, with full floating piston, bored guides, and lay shaft valve gear.

This unit was installed new in 1924. It is in excellent condition and can be shown in operation.

STEAM TURBINE GENERATOR UNITS

3 phase 60 cycle

7500 KVA General Electric condensing turbine generator unit, 2300/4000 volts, 250# steam pressure, with surface condenser

2500 KVA Westinghouse condensing turbine generator unit, 2300 volts, 200# steam pressure, with surface condenser

1875 KVA Westinghouse automatic extraction type condensing turbine generator unit, 480 volts, 175-200# steam pressure, 0-20# extraction pressure, with surface condenser

1563 KVA Allis Chalmers-Kerr noncondensing turbine generator unit, 2300 volts, 150-200# steam pressure, 0-15# back pressure

937 KVA General Electric condensing turbine generator unit, 2300 volts, 150# steam pressure, with surface condenser

625 KVA Westinghouse noncondensing turbine generator unit, 240 volts, 175-200# steam pressure, 0-7# back pressure

312 KVA Crocker Wheeler-Moor noncondensing turbine generator unit, 240 volts, 425# steam pressure, 18# back pressure, 75-125# bleeder pressure

STEAM ENGINE GENERATORS

3 phase 60 cycle

500 KVA Westinghouse generator 2300 volts, direct connected to Nordberg uniflow engine, 175# steam pressure, 5# back pressure

480 KVA General Electric generator, 480 volts, direct connected to Skinner uniflow engine, 150-175# steam pressure, 5# back pressure

312 KVA General Electric generator, 240/480/600/2300 volts, direct connected to Skinner uniflow engine, 125-175# steam pressure, 12# back pressure

260 KVA Western Electric generator, 240 volts, direct connected to Skinner uniflow engine, 175# steam pressure, 5# back pressure

156 KVA General Electric generator, 240/480/600/2300 volts direct connected to Skinner uniflow engine, 150# steam pressure, 5# back pressure

150 KVA General Electric generator, 240 volts, direct connected to Ames uniflow engine, 125-150# steam pressure, 3# back pressure

125 KVA Allis Chalmers generator, 240 volts, direct connected to Skinner uniflow engine, 150# steam pressure, 5# back pressure

DIESEL ENGINE GENERATORS

3 phase 60 cycle

319 KVA Westinghouse generator, 2400 volts, direct connected Fulton diesel engine, 225 RPM

312 KVA General Electric generator, 2400 volts, direct connected Busch-Sulzer diesel engine, 360 RPM

300 KVA Fairbanks Morse generator, 240/2400 volts, direct connected Fairbanks-Morse diesel engine, 257 RPM

STEAM ENGINE GENERATORS

250 volts direct current

600 KW Crocker Wheeler generator, 250 volts, direct connected to Skinner vertical uniflow engine, 150# steam pressure, 5# back pressure

300 KW Westinghouse generator 250 volts, direct connected to Skinner uniflow engine, 150# steam pressure, 8# back pressure

ROTARY CONVERTERS

250 volts direct current

2250 KW (2) Westinghouse self-starting synchronous rotary converters, 230/300 volts, direct current, 450 RPM, with 3 phase, 60 cycle 13200 volt transformers and switching equipment

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

MOTORS • GENERATORS • TRANSFORMERS

MOTORS

3 phase, 25 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	G.E.	KT327	750	1781884
15	Allis Chal.		720	84242
15	G.E.	I-K	750	685100
15	West.	CCL	1500	816324
20	West.	CS	715	2691183
20	West.	CS	730	1949877
18	Otis	15	750	104787V
20	Allis Chal.		720	3K28825
20	Wagner	BP22T	750	119028
20	Reliance		720	220194
25	Allis Chal.	AR20A	750	220-A-623-4209-3
25	G.E.	I4	750	292596
25	Rob. & Myers	K	720	P515362
25	Triumph	TR12	750	C14248
30	Wagner	22VBM8	710	127097
30	Wagner	22VBM3	725	171477
30	West.	CCL	710	602618
30	G.E.	KT327	1440	2302731
40	West. (2200 v.)	CCL	710	854121
38	Otis	AC 750/187½		70062Y
38	Otis	AC 750/187½		70061Y
40	Wagner	22TLBP	1425	318604
40	West.	CCL	710	1032102
50	G.E.	I-K	1455	4015021
75	West.	CS	735	2207524
100	G.E.	KT553	1500	4820366
100	West.	CCL	480	808349
150	G.E.	I-K	363	2246835
150	G.E.	I-K	365	2246834
150	G.E. (2200 v.)	KT557Y b.b.	1460	5227355
150	G.E. (2200 v.)	KT557Y b.b.	1470	5269756
150	G.E. (2200 v.)	KT557Y b.b.	1460	5227354
225	Elec. Mach. (2200/440 syn.)		500	504129
1150	G.E.	ATI (syn.)	375	695425

MOTOR GENERATOR SET

1—125 KW Ridgeway 250 V. DC 1200 RPM, direct connected to 180 HP. Ridgeway Motor 3/60/440 Volts 1200 RPM DC. Panel and Starting Compensator.

FREQUENCY CHANGER SET

1—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM direct connected to Generator 362½/440 V. Complete with exciters and panels.

TRANSFORMERS

3—150 KVA General Electric Type 11, Form KS, 2400 Volts Primary 120/440 Volts Secondary.

REBUILT MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Crocker Wheeler		600	131413
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	9445931
20	Westinghouse	CS	1200	2160590
20	Westinghouse	MS	1200	1056829
20	Westinghouse	MS	1200	1246745
20	Westinghouse	MS	1200	1056827
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	1930159
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Armor	BB	720	4343
30	Crocker Wheeler		720	17270
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	General Electric	I-K	1800	68511
40	General Electric	I-K	1800	77017
40	General Electric	I-K	1800	73316
40	Westinghouse	MS	1800	1506800
40	Westinghouse	MS	1800	1051548
40	Westinghouse	MS	1800	1056802
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	Westinghouse	CS	1800	1949877
50	General Electric	14	1800	181444
50	Reliance		1800	Z20194
50	Allis Chalmers		1800	3K28825
60	Westinghouse	CS	900	4884402
60	Reliance		1200	B11458
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
75	Westinghouse	CS	1800	2134671
100	Westinghouse	CS	900	2207524
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)
125	General Electric	KT562	720	Ball bearing
125	Westinghouse	CS	1200	2318625
150	General Electric	KT568	450	
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	720	122809 (2200 v.)
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	KT568	514	
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	KT568	600	
250	General Electric	I-K	600	2246834
300	General Electric	KT568	720	
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845
400	General Electric	KT568	900	

SLIP RING MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
20	Westinghouse	CW644C	575	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	1558408
40	Westinghouse	CW748	690	4406823
40	Westinghouse	CW748	690	4406825
40	Westinghouse	CW748	690	4406821
40	Westinghouse	CW748	690	4406819
40	Westinghouse	CW748	690	4405824
40	Gen. Elec. (new)	M.445	1200	Ball Bearing
250	Allis Chalmers	3 bearing	505	104390 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

MAGNETIC CONTACTOR

400 HP. Gen. Elect. Type CR. 7006. Form D12D. 3/60/440 Volts.

CURRENT LIMITING REACTOR

60 KVA. Westinghouse 1 Phase 25 Cycle 6.2% on 12000 Volt Lines.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR-GENERATOR SETS

KW	Make	DC Volts	AC Volts
1000	Wtg.	275 Ind.	3/60/4100
750	Elliott	275 Syn.	3/60/440
300	G.E.	275 Syn.	3/60/2200
225	Ideal	115 Syn.	3/60/2200
200	G.E.	250 Syn.	3/60/440
150	G.E.	250 Syn.	3/60/2300
100	G.E.	3 wire Syn.	3/60/480
75	G.E.	125 Ind.	3/25/220
75	G.E.	125 Ind.	3/25/440
90	Wtg.	110 75 KVA	3/60/2300
60	Al. Ch.	110 Ind.	3/60/2300
50	G.E.	115 Ind.	3/60/440
35	G.E.	250 Ind.	3/60/220
35	Century 240	Syn.	3/60/240

SLIPRING MOTORS

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
2850	Wtg.	CW	6600	450
800	Wtg.	CW	6600	507
500	Al. Ch.		440	600
600	Al. Ch.	ANY	2200	1180
600	Wtg.	CW	2300	343
350	Wtg.	CW	220	700
350	G.E. 8b.	IM	2200	600
300	G.E.	IM	2200	514
300	G.E.	MT	2000	450
200	F. Morse		440	600
300	Al. Ch.		440	705
250	G.E.	IM	440	720
250	G.E.	IM	2200	600
150	Al. Ch.	ARY	440	880
150	Wtg.	CW	440	600
100	G.E.	IM	2200	1800
100	Wtg.vert.	CW	2200	1160
100	Ideal	AV	2200/440	720
100	Westg.	HF	440	230
75	G.E.	MT	220	1800
75	G.E.	MT	440	860
60	Al. Ch.	ARY	220	690
50	G.E.	MT	440	1800
50	G.E.	IM	220	900
50	Al. Ch.	ARY	220	690
50	G.E.	MT	2200	600
50	Wtg.	CW	440	570
40	Wagner	TBR	440	1750
40	Al. Ch.	ARY	220	1160
30	G.E.	MT	440	1150
30	Wtg.	CW	220	865
35	G.E.	IM	220	1140
25	G.E.	IM	220	855

This is a partial listing only.

SQUIRREL CAGE MOTORS

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
1000	G.E.	K	2200	509
700	G.E.	HF	2200	1800
500	Wtg.	CS	2200	1750
350	G.E.	KT	440	1765
200(3)	G.E.	KTP	2200	1170
200	Wtg.	CCL	440	1200
200	G.E.	IK	440	580
200	Wtg.	CS	440	600
150(6)	Al. Ch.	AR	440	900
150	Wtg.	CS	2200	720
150	Al. Ch.		440	570
150	G.E.	IK	440	575
100	Wtg.	CS	2200	1750
100	Wtg.	CS	440	900
100	Wtg.	CS	2200	870
75	G.E. tot enc	KF	440	3575
75	G.E.	KT	2200	1800
75(9)	Al. Ch.	AR	2200	1765
75	Westg.	CS	2200	870
75	G.E.	KT	440	870
75	Wtg.	CS	220	600
75	Al. Ch.	CS	440	385
60	G.E.	KT	440	865
60	Wtg.	CS	220	435
60	Wtg.vert.	CS	2200	1750
50	G.E.	KT	440	600
50	G.E.	KT	440	900
50	G.E.	IK	440	1200
40	G.E.	KF	2200	1745
40	G.E.	KT	220	1745
40	Wtg.	C	440	850
40	Al. Ch.		440	850
40	F. Morse	H	2200/440	720
40	Al. Ch.		440	570
35	G.E.	IK	440	1200
35	Wtg.	CS	2200	1175
35	G.E.	KT	220	900
35	G.E.		2200	900
35	Al. Ch.		440	680
35	Al. Ch.		440	480
30	G.E.	KT	220	860
30	G.E.	KT	440	900
30(2)	Wtg.	CCL	220	840
30(2)	Al. Ch.		440	860
30	G.E.	KT	220	600
25	Ideal	AA80	220	1740
25	Cr. Wh.	118Q	440	1150

This is a partial listing only, have NEW from ¼ to 60 hp right in stock.

FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph. 60 cy. 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. 50° synchronous motor with amort. wdg.; dir/conn. to 1000 KW General Electric type ATI-10-1250M-300, 3 ph. 25 cy. 460 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

SYNCHRONOUS MOTORS

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
5000	Wtg.	conds.	2300	900
2100	G.E.	ATI	4600	514
3000	Al. Ch.	conds.	2300	900
1000	Wtg.		440	900
750	Al. Ch.		440	1200
750	G.E.	conds.	550	900
500	G.E.	TS	2200	720
500	G.E.	TS	2200	600
500	G.E.	TS	2300	450
300	G.E.	conds.	480	900
270	G.E.	ATI	440	600
150	Burke	S1375	2200	600
100	Cr. Wh.		240	900
75	G.E.	ATB	220	1200
50	El.M.	.8	240	1200
10	G.E.	ATI	240	900
5	G.E.	K324	220	1800

reluctance type

VARIABLE SPEED D.C. Motors

HP	Make	Type	Speed
100	G.E.	C	1100/1200
25	Wtg.	S9	550/780
25	G.E.	DLC	500/1000
20	Wtg.	SK113	500/1000 (4)
15	G.E.	RC16	500/700
15	G.E.	CE	650/950
14	G.E.	C	700/1400
12	Wtg.	SK80L	500/1000 (2)
10	El. Dyn.		600/1200
12½	G.E.	C	700/1400
4	G.E.	C	800/1400
5	Burke	AM12	500/1500
5	Burke	WAM12	650/1950

A. C. GENERATORS

KW	Make	Volts		Speed
2500	Wtg.	6600		450
1250	Ideal	2200		1200
300	G.E.	480		900
200	Westg.	2400		900
75	Burke	AC16	240	1200
72	F. Morse	AB	440	900
75	G.E.	ATB	230	1200
60	F. Morse	D	2300	300
8	G.E.	ATI	240	900

TRANSFORMERS

KVA	Make	Prl. V.	Sec. V
5—1000	G.E.	13200	2300
2— 667	Moloney	13200	460
3— 500	G.E.	33000	480
1— 100	G.E. 3 ph.	9000	230
3— 75	Wtg.	3810	244/122
2— 50	G.E.	2200	440/220
1— 20	G.E.	2200	220/440
1— 15	G.E.	1050/2100	2200/288
1— 15	G.E.	2400	120/240
1— 7½	G.E. 3 ph.	2200/3810	220/440
1— 7½	G.E.	1100/2200	220/440
1— 6	Kuhlman	100	20
1— 5	Sorgel	140	220
1— 5	G.E.	1100/2200	110/440
1— 5	G.E.	1100/2200	220/440
5— 3	G.E.	440	110/55
1— 3	Moloney	1150	115/230

VERTICAL A.C. MOTORS

HP	Make	Type	Volts	Speed
100	Wtg.	CW	2200	1160
60	Wtg.	CS	2200	1800
35	F.M.	UAV	220	1800
10	G.E.	KT	220	1800
7½	F.M.	b.b.	220	3600
5	Wtg.	CS	220	850

BOILERS

502 HP B & W Stirling water tube ASME, 200 lbs. complete with pulverizer, blowers, fan, etc.

2—800 'Twin setting' B & W Stirling, ASME, 200 lbs. all complete, excellent condition.

2—510 HP Heine straight tube, 200 lbs. less firing equipment.

2—520 HP B & W sectional header straight tube water tube, 200#.

WE ARE ALWAYS IN THE MARKET FOR ALL TYPES OF GOOD MODERN ELECTRIC MOTORS, MOTOR-GENERATOR SETS GENERATORS, TRANSFORMERS, AND OTHER ELECTRICAL EQUIPMENT. SEND US YOUR LISTS FOR BEST CASH OFFERS.

CHICAGO ELECTRIC CO.

1320 W. CERMAK RD. CANAL 2900 CHICAGO 8, ILL.

WAGNER

"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

300 KW Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. MPC motor DC 250 V. 1150 RPM (can furnish A.C. drive).

217 KVA Whse. AC gen. 3-60-120/208 V. coupled to 225 HP type SK motor DC 230 V. 1200 RPM. 3 brg. unit, like new, also operates AC to DC, with panels.

100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage 1-K motor 3-60-2200/4000 V.—1200 RPM.

50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440 V. 1806 RPM.

35 KW Gen. Elec. DLC gen. DC 250 V. to 50 HP AC motor 3-60-220/440 V.

30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.

19 KW Gen. Elec. CD95 gen. DC 65 V. 300 amp. to 30 HP G.E. KT motor 3-60-220/440 V.

Others available — special units built to order

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
125	Fair. Morse	TRC	500	900
100	Northw'n	interpole	230	1700
100	Sprague cradle dynamometer		250	1650/2500
75	Fair. Morse	TR	230	525
60	Triumph	interpole	230	900
60	G.E. Sprague	LC	250	700/2000
50	Whse.	SA	230	450/1350
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
40	Whse. (2)	SK158	230	575
35	Whse.	SK130	230	1100
30	Allis Ch.	E100	230	1800
20	Sprague	LC	230	600/1200
20	Sprague	dynamom	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
20	Gen. Elec.	DLC	230	500/1500
20	Whse.	SK100L	230	900
20	Whse.	SK111	230	250/1000

QUICK SHIPMENT FROM STOCK

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	200	Gen. Elec.	I-K	600
1	150	Gen. Elec.	KTP549	1800
1	150	Whse.	CS	1200
1	150	Whse. New b. b.	CS771.18	1800
1	75	Gen. Elec.	I-K	600
1	50	Gen. Elec.	KT546	600
2	50	Gen. Elec. vertical	KT	1200
2	40	Allis Ch.	AN	1200
1	40	Gen. Elec.	I-K	600
2	40	Allis Ch.	AN	1200
1	40	Howell 440 v.	SCBB	3600
1	40	Gen. Elec.	I-K	1200
2	30	Allis Ch.	AN	1200
1	30	Allis Ch.	AN	600
6	30	Allis Ch.	AN	900
2	30	Gen. Elec.	KT326	1200
2	30	Gen. Elec.	KT336	720
3	25	Whse. New	CS365	1800
1	25	Gen. Elec.	KT322	1200
2	25	Allis Ch.	AN	900
1	25	Allis Ch.	AN	600
1	25	Whse.	CS	720
4	20	Allis Ch.	An	900
3	20	Whse. New	CS364	1800
2	20	Gen. Elec.	I-K	1200
3	20	Whse.	CS	900
1	20	Ideal	AA	1200
3	20	Gen. Elec.	KT312	1200

25 CYCLE MOTORS

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
300	Whse.	CW sl. rg.	500
150	Whse.	HD sl. rg.	500
150	Gen. Elec. 2200 v.	MT359 sl. rg.	1500
100	Whse.	CCL sq. cg.	500
100	Gen. Elec.	I-K	750
75	Whse.	CS	750
75	Cr. Wheeler	75R	500
50	Allis Ch.	ANY sl. rg.	1500
25	Gen. Elec.	I-K	1500

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
750	Allis Ch.		220/440	1200
350	Gen. Elec. 3 brg.	ATB	220/440	600
300	Whse.	ped.	220/440	900
250	Gen. Elec. 1-brg.	ATI	220/440	600
190	Gen. Elec.	ATB	220/440	600
75	Ideal	SMS	220/440	1200

CENTRIFUGAL PUMPS

14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 200 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	400	G.E. 2200 v.	I-P	1200
1	350	Whse. 2200 v.	CW	720
1	300	Burke	EMV	225
1	300	Whse.	HF	400
1	300	Gen. Elec.	MT410	450
1	300	Gen. Elec.	I-P	720
1	250	Gen. Elec.	I-M	600
1	200	Gen. Elec.	I-M	720
1	175	Whse.	MW	450
1	175	Lincoln	IXV	900
2	150	Allis Ch. 3 brg.	ANY	514
1	150	Gen. Elec.	MT562	720
1	100	G.E. 2200 v.	I-E13A	1800
1	100	Gen. Elec. 3 brg.	I-M	450
1	100	Gen. Elec.	I-M	600
1	75	Gen. Elec.	I-M	600
1	75	G.E. 2200 v.	I-E13	1800
1	65	P. & H. b. b. Int.	CA16	900
1	60	Whse. 2200 v.	CW657	1800
2	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Al. Ch. b. b. 2200 v.	ARY	900
1	50	Gen. Elec.	I-M	600
1	40	Gen. Elec. 2 ph.	MQ536	900
1	40	North'n	HW35A	1200
2	40	Gen. Elec.	MT532	1200
1	40	Fair Morse b. b.	HV	900
1	40	Whse.	CW	900
2	40	Gen. Elec.	M546	514
2	40	Allis Ch.	ANY	450
1	35	Fair Morse, b. b.	HV	1800
1	30	Northwestern b. b.	HW404	1800
2	30	Allis Ch.	ANY	900
2	30	Whse. enclosed	MA	600

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
60	Allis Ch.		125	900
50	Cr. Wheeler	CC	125	1800
40	Whse.	SK	250	720
35	Gen. Elec.	DLC	250	900
35	Whse.	SK130	250	1150
30	Lincoln b. b. 600 amp.		50	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	LC	250	900
20	Whse.	SK	250	1300
19	Gen. Elec. 300 amp.	CD	65	1200
16	Cr. Wheeler	CCD	125	415

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60 CYCLE A. C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
500	Gen. Elec. 3 brg.	ATB	2300	450
300	Gen. Elec. 3 brg.	ATB	240/480	600
300	Whse.	ped.	240/480	900
300	Elec. Machy. 3 brg.		240/480	720

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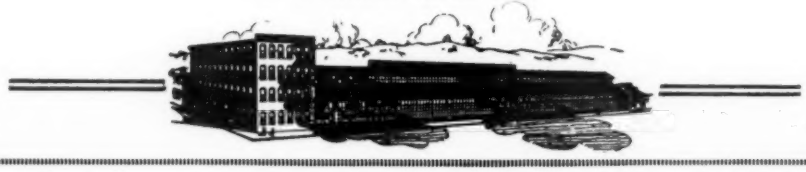

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1—22500 KW General Electric Cond.
1—15300 KVA Westinghouse Cond.
1— 7500 KVA General Electric Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 3125 KVA General Electric Extrac.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 750 KVA General Electric Cond.
1— 625 KVA General Electric Cond.
1— 625 KVA General Electric Non-C.
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

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1—1500 KW General Electric 250 V.
2—1000 KW General Electric 250 V.
1— 125 KW General Electric 125 V.
1— 75 KW General Electric 125 V.
1— 25 KW Westinghouse 125 V.

STEAM ENGINE UNITS—60 Cy.
1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 375 KVA Skinner Uniflow
1— 375 KVA Harrisburg Uniflow
1— 350 KVA Ames Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 210 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow
1— 94 KVA Ridgway 4-valve
1— 93.8 KVA Skinner Uniflow

D. C. STEAM ENGINE UNITS
1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—150 KW Ridgway 4-valve 125/250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

OIL & GAS ENGINE UNITS
1—625 HP Worthington, 240 V. 60 cy. gen.
1—520 HP Busch Sulzer, 2400 V. 60 cy. gen.
1—450 HP M.A.N., 2300 V. 60 cy. gen.
1—440 HP Nordberg, 250 V. DC gen.
1—375 HP Worthington, 240 V. 60 cy. gen.
1—375 HP McInt. & Sey., 240 V. 60 cy. gen.
1—320 HP Winton, 240 V. 60 cy. gen.
1—300 HP McInt. & Sey., 480 V. 60 cy. gen.
1—175 HP Sterling (gas), 480 V. 60 cy. gen.
1—150 HP Superior, 240 V. 60 cy. gen.
2—125 HP Winton, 240 V. 60 cy. gen.

WATER TUBE BOILERS
1—1392 HP Springfield 400 lb., Pulverizer
1— 880 HP B. & W. 250-lb., Stoker
1— 612 HP Stirling 200-lb.
6— 600 HP B.& W. 200-lb., Stokers
2— 560 HP Erie City 460 lb.
1— 484 HP Springfield 200-lb., Oil Fired
2— 481 HP Springfield 225-lb., Pulverizer
2— 407 HP Wickes 160-lb., Stokers
2— 405 HP Erie City 160-lb., Stokers
2— 312 HP Stirling 160-lb., Stokers
2— 300 HP Heine 200-lb.
2— 300 HP B. & W. 160-lb.

SYNCHRONOUS MOTORS
1—1700 HP West. 60 cy. 2300 V. 300 RPM
1— 600 HP G. E. 60 cy. 2200 V. 600 RPM
1— 375 HP G. E. 60 cy. 2300 V. 1800 RPM
1— 200 HP Ideal 60 cy. 4000 V. 514 RPM
1— 175 HP West. 60 cy. 4000 V. 514 RPM
1— 150 HP West. 60 cy. 2200 V. 600 RPM
1— 100 HP G. E. 60 cy. 2300 V. 240 RPM (Super)
1— 100 HP G. E. 60 cy. 4000 V. 1800 RPM

INDUCTION MOTORS—60 Cy.
4—3500 HP G. E. slip ring 2300 V. 120 RPM
1—2500 HP G. E. slip ring 6600 V. 253 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
2— 400 HP G. E. slip ring 3800 V. 1800 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
1— 150 HP G. E. slip ring 440 V. 450 RPM
1— 100 HP G. E. sq. cage 2200 V. 900 RPM
1— 75 HP G. E. sq. cage 440 V. 514 RPM

MOTOR GEN. SETS—60 Cy.
1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 200 KW Westinghouse 250 V. DC
1— 150 KW Westinghouse 250 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.
2—2600 KW General Electric 250 V.
2—1700 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
2— 500 KW Westinghouse 600 V.

FREQUENCY CHANGERS
2—12500 KW G. E. 60/25 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 1875 KVA G.E. 25/60 cy. 300 RPM
1— 1500 KW West. 60/25 cy. 300 RPM
1— 1250 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 60/25 cy. 300 RPM
3— 300 KVA G.E. 3000/60 cy. 1800 RPM

TRANSFORMERS—1 Ph. 60 Cy.
4— 500 KVA West. 110,000-2300 V.
3— 4000 KVA West. 63.5/110-19/33 KV
4— 2500 KVA G.E. 63.5/110-19/33 KV
3— 2500 KVA Pitts. 6600-25400/12700 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA Pitts. 66000-33000 V.
3— 333 KVA G.E. 66000-480 V.
3— 100 KVA G.E. 66000-6900/11000 V.
3— 1667 KVA G.E. 44000-2300/4000 Y V.
3— 833 KVA Al. Ch. 34460-4800/2400 V.
3— 200 KVA G.E. 33000-2300/4000 Y V.
3— 150 KVA G.E. 22000-2300 V.
3— 75 KVA G.E. 33000-13200/11000 V.
14— 75 KVA G.E. 33000-2400 V. New
40— 50 KVA G.E. 33000-2400 V. New
50— 25 KVA G.E. 33000-2400 V. New
1—15000 KVA Al. Ch. 27880-4560 V. 3 ph.
2—10000 KVA West. 26400-4560 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
3— 667 KVA Packard 23000-440 V.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 200 KVA G.E. 22000-230/460 V.
1—10000 KVA West. 13200-4560 V. 3 ph.
1— 3000 KVA Kuhlman 13800-480 V. 3 ph.
3— 1667 KVA Pitts. 13200-2300 V.
4— 1250 KVA Pitts. 13500-230/460 V.
3— 200 KVA G.E. 13200-480 V. Pyranol
3— 150 KVA Pitts. 13800-460/230 V.
3— 100 KVA West. 13200-2300 V.
3— 100 KVA G.E. 6900-230/460 V.
3— 75 KVA G.E. 6900-230/460 V.
6— 25 KVA West. 6900-230/460 V.
3— 833 KVA Penn. 4800-240/120 V.
3— 150 KVA G.E. 2400-120/240 V.

OIL CIRCUIT BREAKERS
6— 400 A. 37 KV G.E. FHKO136 Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
1— 400 A. 25 KV G.E. FKO136 Outdoor
2— 600 A. 15 KV G.E. FKO37 Outdoor
1— 600 A. 15 KV West. O-221 Outdoor
2— 400 A. 15 KV G.E. FHKO136 Outdoor
3—400 A. 15 KV G.E. FK132B Indoor
2—1200 A. 7.5 KV G.E. FK132B Indoor
6—1200 A. 4.5 KV Condit D-12 Indoor

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1—2000 KW. 600 V. Cond.
1—1500 KW. 2300 V. Cond.
1— 750 KW. 2300 V. Cond.
1— 750 KW. 600 V. Cond.
1— 500 KW. 440 V. Non. C.
1— 500 KW. 125 V. D. C.
1— 375 KW. 440 V. Cond.
1— 200 KW. 2300 V. Cond.
1— 120 KW. 440 V. Non. C.

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1—168 KW. 550 V.
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1—600 KW. 2300 V.
1— 75 KW. Uniflow 240 V.

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1—500 H.P. 200# Oil
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2—480 H.P. 225#
1—305 H.P. 185# Stoker
1— 90 H.P. Ames Ecom.
4—150 H.P. 150# H.R.T.

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1—1485 Sq. Ft. Surface

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1—860, C.F. 50# Diesel
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1—1214 C.F. 100# Motor Driven
1—600 C.F. 350# Steam Driven
1—386 C.F. 100# Steam Driven

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1—1000 GPM Fire Motor Steam
1—750 GPM Fire Pump Steam

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SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
20	Westg.	220	575	CW
20	Allis Chal.	440	1130	
25	Westg.	220	720	CW
50	West.	220/440	860	CW
50	West.	220/440	720	CW
50	West.	220/440	1120	HF
50	Westg.	440	1145	HF
50	Chandeys'n	220/440	1800	
60	West.	220/440	720	CW
75	West.	220/440	900	CW
75	West.	220/440	720	CW
100	West.	220/440	900	CW
100	West.	440	690	HF
150	G.E.	220/440	1200	M-I
200	G.E.	220/440	1200	M-I
260	Burke	440	600	EMV-65
300	G.E.	440	900	I
400	Westg.	2200	435	CW-1214

ALTERNATING CURRENT MOTORS

3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
20	West.	220/440	625	CS (Elev.)
25	Wagner	220	900	
25	West.	220/440/550	1200	CS
30	West.	220	450	CS
30	Wagner	220	1140	
30	Lincoln	220	600	
35	Lincoln	220/440	720	
35	West.	220/440	495	CS
35	West.	220/440	575	CS
70	Howell	220	900	SO
40	West.	220/440	720	CS
40	Lincoln	220	900	
45	West.	220/440	850	CS
50	West.	220/440	900	CS
50	West.	220	600	CS
50/150	West.	2200	360/720	CS-954
50	Chandeys.	220/440	1800	
50/32	G.E.	440	800/640	
60	Allis Chal	220/440	1760	
100	West.	440	690	HF
100	Allis Chal.	220	600	
150	Wagner	440	1800	31V
175	G.E.	2200	600	I-12
200	Westg.	2200	900.	
1500	G.E.	2200/220/440	225	ATI-Syn.
3500/4000	West.	4000/23000	900	Syn.

VARIABLE SPEED MOTORS—230 VOLT D.C.

H.P.	Make	R.P.M.	Type
2	Star	400/600	SB
2	G.E.	400/1600	RLC
2	G.E.	415/830	RLC
2	Reliance	550/2000	
2¼	Westg.	450/900	SK-30
2½	G.E.	500/1000	RLC
2½	Reliance	509/1000	14T
3	Jants-Liest	650/1950	RI-DC
3	Roth (enclosed)	500/1000	RS
3	G.E.	400/1200	RLC-114
3¼	Westg.	400/1600	SA
3½	Westg.	850/1700	
4	G.E.	850/1700	LC-8
5	G.E.	500/1000	
5	Reliance	600/1800	
7½	Westg.	450/900	80L
7½	Westg.	400/1600	SA
10	Westg.	565/1130	S-6
10	G.E.	625/1250	LC
15	Reliance	500/1800	
20	Westg.	750/1500	SK-110L
30	G.E.	450/900	RLC
75	West.	400/650	SK-181

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
6	Ilg.	230	380	
10	West.	175	1200	V-67
10	West.	230	650	MT-00
15	Cr. Wh.	220	270	SM
15	West.	230	800	HD
25	West.	230	600	MT
32	Shaw	230	485	5L2E
68	G.E.	220	475	
80	West.	230	490	76-A
175	G.E.	230	475	MD

TRANSFORMERS

1 ph. 60 Cy.

No.	Kva.	Pri.	Sec.	Make
1	2	1040/2080	52/104	G.E.
1	2	6600	110/220	G.E.
1	2½	1040/2080	52/104	G.E.
2	3	2200/2100/2000	440/220/110	West.
1	3	2200	110/220	G.E.
1	5	2000/4000	80	West.
3	5	2200	220/440	G.E.
4	5	2200/1100	110/220	G.E.
1	5	2200	110/220	West.
4	5	2200	110/220	G.E.
1	7½	2200	110/220	West.
69	7½	1100/2200	110/220	G.E.
29	7½	2200/1100	110/220	West.
8	7½	2200/1100	440/220/110	West.
6	10	2200/1100	220/110	West.
10	10	2200/1100	220/110	G.E.
2	10	2300	220/110	G.E.
1	10	2200/1100	440/220/110	West.
21	15	2200/1100	440/220/110	West.
3	15	2200	220/440	G.E.
2	15	2300	230/460	American
3	15	2200	110/220	Packard
3	15	2200	110/220	Cr. Wh.
16	18	220	19½/38½	El. Furnace
2	20	1150/2300	115/230	Maloney
2	20	2300	230/460	American
1	20	2300	110/230	West.
2	20	2300/110	440/220/110	West.
2	25	2300	230/460	American
2	25	2300	110/220	West.
18	37½	2400	480/240	G.E.
3	40	2300/1100	220/110	West.
1	40	1100/2200	110/220	Pittsburgh
1	40	2300/1150	113/230	Maloney
2	50	2200	110/220	Packard
1	50	6600	550/440	Allis Chal.
1	50	2200/1100	220/110	West.
2	50	2200/1100	220/110	Maloney
3	75	2300	206–103 Rotary	G.E.
9	75	2400	240/480	G.E.
1	100	2300	230/115	Standard
6	112.5	2400	240/480	G.E.
3	125	2200	220/440	G.E.
2	150	2200/2300/2400	220/230/240	G.E.
3	250	6600/5940	2300	West.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari time magnetic controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS & ROTARY CONVERTERS—250 V. D.C.

1—5kw. Allis Chalmers 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.

1—7½ kw. West. 1150 rpm. Gen. dir. conn. to 220/440 220/440 v. 3 ph. 60 cy. Induction Motor.

1—10 kw. West SK 1150 rpm. Gen. dir. conn. to 220/ v. 3 ph. 60 cy. Induction Motor.

1—15 kw. West. 1150 rpm. Gen. dir. conn. to 220/ 440 v. 3 ph. 60 cy. Induction Motor.

1—20 kw. West. 1150 rpm. Gen. dir. conn. to 220/ 440 v. 3 ph. 60 cy. Induction Motor.

1—25 kw. Triumph 1750 rpm. Gen. dir. conn. to 220/ 440 v. 3 ph. 60 cy. Induction Motor.

1—25 kw. West. 1150 rpm. Gen. dir. conn. to 220/ 440 v. 3 ph. 60 cy. Induction Motor.

1—70 kw. West. 250 v. 575 rpm. DC Gen. dir. conn. to 440 v. 3 ph. 60 cy. AC Motor.

1—100 kw. 250/275 v. Rotary Converter ped. type, 6 pole 1200 rpm. complete with switchboard and 3—35 kva. G.E. 2300 v. 1 ph. 60 cy. Transformers.

1—150 kw. West. 250 v 900 rpm Gen dir conn to 290 HP 440 v. 3 ph. 60 cy. West. Syn. Motor.

3—250 kw. Cr. Wh. 250 v. 500 rpm. DC Gens. with 3—250 kva. Cr. Wh. Syn. 220 v. 3 ph. 25 cy. Motors.

125 volts

1—5 kw. Wotton Vert. 88/110 v. DC 1750 rpm. M.G. Set Motor rated at 4 HP 220 v. 1 ph.

1—5 kw. Wotton Vert. 88/110 v. DC 1750 rpm. M.G. Set Motor rated 4 HP 220 v. 3 ph.

1—5 kw. Martin Rotary Converter 70/110 v., DC 1800 rpm. 2 or 3 ph. 60 cy. AC.

1—5 kw. 125 v. 1150 rpm. Allis Chal. Gen. dir. conn. to 3 ph. 60 cy. 220/440 v. AC Induction Motor.

1—10 kw. West. 120 v. DC Syn. Converter 1600 rpm. 3 ph. 60 cy. A.C.

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2-300 K. W.

BURKE 250/125 volts

Direct Current

SYNCHRONOUS MOTOR GENERATOR SETS

SPECIFICATIONS

2—300 K.W. Burke 4 bearing Synchronous Motor Generator Sets, 3 wire, 250/125 volts Direct Current, Type CB67, 900 R.P.M. 1200 Amperes, Compound Interpole, Serial Nos. 136014 and 136129 on common sub-base direct connected to 450 H.P. 4160 volt, 3-phase, 60 cycle, .85% P.F. Synchronous Motor, type AC88, Serial Nos. 136010 and 136011.

Complete with A.C. Reduced Voltage Starting Panel with auto transformer and D.C. Panel Board

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SLIP RING MOTORS

3-HP., 60.CY.

HP	Volts	Make	Speed
400	440	G.E.	360
300	2200/440	G.E.	600
300	440	G.E.	450
300	440	Al. Chal.	900
300	2200	G.E.	1800
250	2300	G.E.	600
250	440/550	G.E.	600
250	440	Whse.	450
250	550	Al. Chal.	900
200	2200/440	G.E.	1200
200	2200/440	G.E.	600
150	440	G.E.	1800
150	4000/2300	G.E.	1800
150	2200/440	G.E.	600
125	440/220	G.E.	1200
125	440/220	G.E. (Hoist)	900
125	2300	G.E. (New)	1800
100	440/220	G.E.	1800
100	220/440	G.E.	720
100	220/440	G.E.	900
100	440/220	G.E. MTC	900
100	550	G.E.	900
75	440/230	Whse.	720
75	550	G.E.	900
60	2200	G.E.	900
40	2200	Whse.	900
40	2200	G.E.	1200

SYNCHRONOUS MOTORS

3-HP., 60.CY.

300	440/220	Al. Ch.	600
200	2200	Whse.	900
110	440	Whse.	900
100	2200/550	Al. Ch.	1800
100	440/220	G.E.	360
75	440/220	G.E.	720

OUTDOOR OIL CIRCUIT BREAKERS

1—New 400 Amp. Type FK. 134-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.

1—1200 ampere, type D 12, Condit, 7500 volt, 3 pst, hand-operated.

1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

TRANSFORMERS

60 CYCLE

2—500 kva., G.E., type H, form KS, 13800-230/460.
2—250 kva., Whse., 13,800-460.
2—250 kva., G.E., H KDD, 13200-2300/575 V.
2—200 kva., G.E., type H, 34500-2300 V.
2—150 kva., G.E., H-KDD 13200-2300.
2—150 kva., Al. Ch., type OISC 10400-2400.
3—150 kva., G.E., H-KS, 2400-240/120 V.
2—150 kva., G.E., HTQ, 4150-240/480 V.
3—100 kva., Whse., SK, 4200-460/230 V.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., G.E., tyoe H-KR 6600/11430Y-2300 V.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230-115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200/440	Whse.	CS	720
250	440/220	G.E.	IK	1800
200	220/440	G.E.	IK	720
200	440/220	G.E.	IK	900
200	440/220	G.E.	IK	1200
150	440/220	G.E.	KT	720
150	440/220	Whse.	CS	514
125	440/220	G.E.	KT	1800
125	440/220	G.E.	K	514
125	440/220	G.E.	KT (Vert).	1800
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
74	2200	G.E.	KT	900
75	2200	G.E.	IE-K	1800
50	220/400	G.E.	K	1800

MOTOR GENERATOR SETS

1—75 KW, 250 V. 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V. 850 RPM, Whse. conn. to 75 HP, 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.
1—50 KW., 125 V., 1200 RPM. Whse conn. to 75 H.P. 2200/220 V.; 3 ph., 60 cy., Sq. Cage Motor.
1—25 kw. 250 V, 1800 rpm, GE, conn. to 35 hp. 440 volt, 3 ph., 60 cy., Sq. Cage

A.C. GENERATORS

1—375 kva, 514 rpm, 480/240 V, GE
1—250 kva, 600 rpm, 440/220 V, Al. Ch.
1—110 kva., 900 r.p.m., 440 V., G.E.
1— 96 kva., 360 r.p.m., 480/240 V., G.E.
1—62½ kva., 1200 r.p.m., 2200 V., Cr. Wh.

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2—1060 H.P. Heine Boilers 200#
4—1000 H.P. Heine 225# Boilers
2— 750 H.P. Edge Moor 200# Boilers
2— 750 H.P. B. & W. Sterling Boilers 200#
4— 600 H.P. B. & W. 200# Boilers
2— 600 H.P. Edge Moor 200# Stokers
4— 440 H.P. B. & W. Sectional 200# Oil fired
1— 335 H.P. B. & W. Sectional 200#
Smaller Boilers and Fire Tube Boilers also

1—15000 K.W., G.E. Co., Turbo-Generator Condensing
2—12500 K.W., G.E. Co., Turbo-Generator Condensing
1— 5000 K.W., G.E. Co., Turbo-Generator Condensing
3— 4000 K.W., G.E. Co., Turbo-Generator Condensing
2— 2500 K.W., G.E. Co., Turbo-Generator Condensing
2— 2000 K.W., G.E. Co., Turbo-Generator Condensing
1— 2000 K.W., W. E. & M. Co., Turbo-Generator Con.
3— 1000 K.W., G.E. Co., Turbo-Generator Condensing
2— 750 K.W., G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller. And Non-Cond. Units

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New and rebuilt
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Motor Generator Sets—Synchronous Motors, Etc.

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G.E. 350 KW 1200 RPM 275 Volts Type HCC

SLIP RING MOTORS

3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SYNCHRONOUS MOTORS

3 phase, 60 cycle, A. C.

1—Ideal 3-bearing 250 HP 600 RPM 440 Volt
1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

VERTICAL MOTORS

1—Reliance fan-cooled 25 HP 1750 RPM 220/440 Volt

D. C. EQUIPMENT, 230 VOLT

1—G.E., MPC 150 HP 262/750 RPM
1—Triumph 110 HP 292/600 RPM
1—Diehl 125 HP 400/1200 RPM
A large number of adjustable speed D.C. motors from 5 to 100 HP.

ALTERNATORS SPECIAL, Allis-Chalmers, 125 KVA 277 RPM 3 Phase, 60 Cycle

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New York, N. Y.

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CONDENSING

3750 KVA Wghse. 600 v. (bleeder)
3750 G.E. 2300 v.
3125 G.E. 480 v. (bleeder)
2500 Wghse. 600 v.
1560 (2) Al. Chal. 600 v.
1560 Wghse 480 v. (bleeder)
937 G.E. 2300 v.
625 KVA. G.E. 2300 v.
500 (3) G.E. 240 v.
375 G.E. 2300 v.
312 Elliott-Kerr, 480 v.
312 Moore (bleeder & Non-con.)

NON-CONDENSING

625 KVA. Al. Chal.-Terry 2300 v.
110 KVA Al. Chal. 240 v.
50 Terry, 240 v.

BOILERS

880 HP B & W 200#
612 Sterling 200#
328 HP. (4) Sterling 160 lb.
300 (2) Union I. 175#
275 (2) B & W 160#
180 B & W 3 drum, 160#

DIESEL UNITS

300 KVA FM style VA
210 Burke-Buckeye 3 cyl.
62½ KVA Al. Chal.-Buda.
120 HP. Chicago Pneumatic, belted

TRANSFORMERS
PUMPS (MOTOR DRIVEN)
COMPRESSORS
MOTOR GENERATOR SETS

PUMPS MOTOR & STEAM DRIVEN

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3500	140′	Kingsford	Centrif.
2400	55′	American	Centrif.
1100	220′	Allis-Chalm.	Centrif.
1500	160′	De Laval	Centrif.
400	625′	LeCourtenay	Centrif.
250	535′	LeCourtenay	Centrif.
400	350′	Goulds	Triplex
300	500′	Goulds	Triplex
175	500′	Goulds	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
300	150′	Viking	Rotary
1000	460′	Knowles	Steam
750	460′	Snow	Steam
500	100′	Foster	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

M. G. & STEAM DR. SETS

K.W.	Make	Volts	Type
25	Green Eng.	220 D. C.	Belt Drive
100	Ames	240 D. C.	dir. dr. Eng.
75	Ames	240 D. C.	dir. dr. Eng.
17	Sturt. Turbine	110 D. C.	Direct Drive
7½	Sturt. Turbine	110 D. C.	Direct Drive

D.C. MOTORS ALL SIZES

100 Northwest	230	1750
25 Roth	230	1750
10 Crock. Wheel	110	925
10 Weschge	110	1700

1½ to 7½ H. P. ALL MAKES

CONDENSATION RETURN UNITS

Nash-Jenn Dump. Vac. Heat, 26000EDR
Nash-Jenn Simp. Vac. Heat, 1600EDR
Condensation Units, 100 to 250,000EDR

AIR COMPRESSORS

G.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
140	125	Curtis	Vert. Dup.
100	125	Ing. Rand	Vert. Dup.
28	5000	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

1800	5¼ lbs.	In. Rand	Motor dr.
1350	24 oz.	Spencer	Motor dr.
900	10½ lbs.	In. Rand	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24-45 oz.	Spencer	Motor dr.
450	24 oz.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor dr.

BLOWERS & EXHAUSTERS

C.F.M.	St. Pres.	Make	Type
100–60000	¼"–5"	Buffalo	Various
100–15000	¼"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press	Make	Type
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
500	3 lbs.	Roots	Belt dr.
235	1 lb.	Fuller	Direct dr.
110	15 lbs.	Beach R	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth	Belt dr.
100	high vac	Beach R	Gear dr.
100	27 in.	Deane	Belt dr.
100	29 in.	Devine	Belt dr.
100	20 in.	Nash	Direct dr.

MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
150	West.	440	700	CS
125	G.E.	220	1150	Vertical
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	242
30	Wagner	220	850	Sl. rg.

Also 10 to 30 H.P. in All Makes

SIMILAR EQUIPMENT IN STANDARD MAKES AND SMALLER SIZES
HIGHEST PRICES PAID FOR YOUR IDLE EQUIPMENT

STEAM ENGINES
Turb. Cent. Bronze Pumps
Steam Pumps—All Sizes
10"x10" Greenfield Vertical
7"x7" Wickes Bros. Vertical
6"x6" Vertical & Smaller
1 to 40 H.P. Steam Turbines

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WITH COND.—4100 V.—2300 V., 60 Cy., 3 Ph.

2—4166 GPM. 162' HD. CENT. PUMPS (PRAC. NEW), 12" SUC.—12" DISC.
36000-25000 GPM. 27'-40' HD. CENT. PUMP 42" SUC. 36" DISCHARGE
20" AND 24" VALVES—ELLS—TEES—(PRAC. NEW)
1500 CFM 2 Stage Aircomp. 275 HP. 60 Cy. 2200 V. Syn. Mtr.
250 HP. WT. BOILER WITH SPREADER TYPE STOKER, 150 KW. AND 250 KW. ENGINE SETS, 440 VOLT, 60 CYCLE, 3 PHASE, AND AUXIILIARIES.
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1625 HP. 240 RPM. 1600 HP. 550' HD. 1500 HP. 150' HD.
725 HP. 160' HD. 310 HP. 450 RPM, WITH AC GENERATOR
425 KVA. 2200 V. GEN. DIR. 60' HD. 500 HP. 35 HEAD 300 RPM.
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Good Values

1 — G. E. 100 KW, 3 ph, 2300 volt, 3600 RPM Non Condensing, 125 PSI
1 — G. E. 200 KW, 3 ph, 2300 volt, 3600 RPM, non-condensing, 150 PSI
1 — Allis Chalmers 650 KW, 3 ph, 2300 volt, 3600 RPM condensing, 200 PSI
1 — Westinghouse, 1000 KW, 3 ph, 2300 volt, 3600 RPM, condensing
1 — Complete Steam Generator Plant, 2600 KW, total capacity. G. E. 440 volt, 3 ph, 60 cycles. 2 units 1000 KW and 1 unit 600 KW Condensers, switchboard and 4 HRT 72x18 Boilers
1 — Steam Generator Plant, 3300 KW, total capacity.
Allis Chalmers 2000 KW } condensing
Allis Chalmers 800 KW }
G.E. 500 KW mixed pressure

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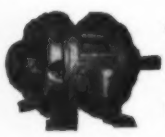

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4—600 A GE FK 13 3 PST 15,000 V. Handle. Trip Coils and Currents.
1—800 A Conduit E4 600 V. 3 PST Handle. Trip Coils and Currents.
1—1200 A. GE FK 132 A 3 PST 7500. Handle with Trip Coils and Current Transformer.
1—3000 A GE CK 8 Air Breaker 3 PST 600 V. O.I. & U.V.
1—3000 A GE FK 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

Sq. Cage—220/440 V. 60 Cy. 3 ph.

Qu.	HP	Make	Type	Speed
2	50	G.E.	KT 327	1800
2	100	G.E.	IK	1800
1	150	West	CS	1800

Slip Ring—220/440 V. 60 cy. 3 ph.

1	40	West.	CW	720
1	50	G.E.	I-M	900
1	50	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

D. C. Variable Speed 230 V.

1	15	West.	SK	400/1600
1	25	West.	SK	400/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

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1—Snow 8 MGD C&FW cr. Com. Opp. Type Cond. 26x54x17x36, with waterworks type condenser.
1—Snow 6 mgd. C&FW Cr. Com. Opp. Type Cond. 20x40x14¾x36, with waterworks type con.
1—Allis-Chal. 4 mgd. cr. com. cond. Size 12x28x13x24. All fine cond.
1—Platt Iron Wks. Cr. Comp. C&FW Meyer Valve Gear Cond. 1000 GPM. Size 14x28x9¾"x18.

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Birch Valves for all types of reciprocating

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1—20" Rensselaer #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod and Eyebolt, 100#.

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1—125 KW Syn. Motor Gen. Set—like new
2—150 KVA Diesel Engine—Generator Sets
1— 50 KVA Generator dir. con. Steam Engine
1—4000' Air Compressor & 750 HP Diesel Engine
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1—280 KVA F-M Diesel Engine—Generator Set
1—150 KW, 220 V. AC Gen. dir. con. 4-Val. Eng.
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2—200 KW Syn. M. G. Sets 440 AC—250 DC
1—3000 KW 120 RPM slip ring motor and control
1—360 HP 240V AC F. Morse diesel set.
90 & 46 KW 240V AC uniflow engine sets
Complete diesel plant (3) 160 HP 240 V AC sets.
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WRITE OR WIRE YOUR NEEDS TO
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FOR SALE

AT OUR EAST PEORIA STATION

1126 W. Washington St., Peoria, Ill.

1—1392 H.P. Springfield sectional all steel water tube boiler built for 400 lbs. working pressure with Tracy steam purifier, Vulcan soot blowers, 1180 sq. f.t water screen Elesco steam superheater with 1605 sq. ft. of heating surface, temperature raise 250 degrees; 1—1441 sq. ft. Foster economizer with Diamond soot blowers and 1 Green type SA double inlet steel plate induced draft fan complete with 200 H.P. motor and controller. Capacity of unit 160,000 lbs. per hour at 375% of rating.

1—6 ton, 6 roll Raymond vertical mill complete with air separation system including collector, No. 12 exhauster, discharge and return air piping, feeding and burning equipment, all complete with motors and controllers.

CENTRAL ILLINOIS LIGHT COMPANY

Peoria 2, Illinois

FOR SALE

1—400 H.P. B & W Water Tube Boiler 160 Lbs.
1—350 H.P. B & W Water Tube Boiler 150 Lbs.
1—300 K.W. General Electric Turbine Generator Set 3/60/2300.
1—250 KVA. Allis-Chalmers, Moore Turbine Generator Set 3/60/2300.
1—100 K.W. Allis-Chalmers Generator Direct Connected to 14" x 16" Skinner Engine. 3/60/220
1—100 KVA Crocker-Wheeler Belt Generator 3/60/2300
1—120 H.P. Fairbanks-Morse Model 32-E-12 Two Cylinder Oil Engine.

TENNESSEE MACHINERY CO.

121 Third Ave. S., Nashville 3, Tenn.

SKINNER STEAM ENGINE

16 x 15, left hand, center crank automatic engine, Belted type with special extended shaft and outboard bearing. 275 R.P.M. under pressure 70 to 80 lbs. at throttle, zero to 5 lbs. back pressure. Weights for governor so speed can be reduced to 150 R.P.M. Engine built to run under. This engine in good running order and will be sold cheap.

TRIANON LANES

9802 Euclid Ave. Cleveland, Ohio

75 NEW BRONZE ALLIS-CHALMERS PUMPS

Priced at Fraction of Original Cost. Immediate Delivery. *No Priority Needed.*

All bronze, ball bearing, centrifugal pump units consisting of two pumps on one shaft; setup for either direct drive or pulley drive. These are marine type pumps for salt and fresh water, but can be used for chemicals, foods, distilleries, etc. Without motors. Sizes: 3", 3½", 4", 4½" and 5". Unit weighs approximately 350 pounds. G.P.M. 350 to 600, FT. HD. 60 to 90, R.P.M. 3300. Photo and specs sent on request.

AMERICAN SALES COMPANY

1562 Harrison Ave. Cincinnati 14, Ohio

FOR SALE

One Frick Vertical single acting, Corliss driven Ammonia Refrigerating machine, 8½x12x10, rated at 15 tons. Unit has been used very little and is in good operating condition.

For information apply, A. G. CHRISTIE

Johns Hopkins University, Baltimore 18, Md.

FOR SALE

1—100 GPM Worthington 125 lbs. centrifugal fire pump direct connected on base to 100 HP Westinghouse Type CS 3/60/2300 1800 RPM motor.
1—1R cross compound 300 RPM air-compressor cylinder 11" and 7" by 10" belt-driven by 60 HP Westinghouse 3/60/2300 volt slip ring motor.
1—1R Type 10 cross-compound steam driven air-compressor air-cylinder 12" and 7½" by 12" 100 lbs. pressure.
1—250—HP Casey-Hedges water tube boiler 150 lbs.
1—500 KW GE steam turbine 150 lbs. steam condensing direct connected to 500 KW 3/60/2300 volt 3600 RPM GE turbo-generator with wheeler surface condenser.
3—728 HP each Erie City boilers Type No. 6-S vertical bent tube water tube. ASME code 180 lbs. with individual stacks.
1—GE 1250 KW 3 stage steam turbine 150 lbs. gage surface condenser direct connected to GE 3/60/2300 volt 1250 KW turbo-generator 1.00% P.F.
1—GE 600 KW 175 lbs. form B 4 stage surface condenser steam turbo direct connected to GE 3/60/2300 volt 600 KW pf. 8 turbo-generator.

RALPH H. ROGERS & CO.

306 Millsaps Bldg.

Capital & Roach Sts. Jackson, Miss.

REBUILT

SLOW SPEED

MOTORS

SQUIRREL CAGE

H.P.	Make	Type	Volts	RPM
5	L.-Allis	Sq. C.	220	4 Speed
15	G. E.	HI	440	900
20	Westgh.	C	440	840
25	Cent.	AS-35	220	865
25	G. E.	HI	440	900
35	G. E.	I-12	2200	600
35	G. E.	HI	440	900
50	West. El.	I	440	600
50	G. E.	KT346	2300	685
50	Westgh.	CS	440	870
50	G. E.	I	220	900
150	G. E.	I	2200	575

SLIP-RING

7½	Westgh.	CW	440	870
18	G. E.	IOC5010	220	720
20	Allis-C.		440	860
20	G. E.	I-11	2200	900
20	Flyn-W.	MT326	2300	855
25	G. E.	I-10	220	670
35	G. E.	I	2200	600
50	G. E.	MT356	220	450
50	Al. Ch.	AR	2200	580
50	G. E.	I-8	2200	860
100	G. E.	I-M	220	450
250	Westgh.	CW	440	503

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1—1000 KW, 250 V—DC, 4000 V—AC, 3 PH.
2—1000 KW, 600 V—DC, 4000 V—AC, 3 PH.
2— 300 KW, 250 V—DC, 11500 V—AC, 3 PH.

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1—150 KW, 275 V—DC, 2300 V—AC, 3 PH.
1—100 KW, 275 V—DC, 2300 V—AC, 3 PH.

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Units Noted Below Are Now In Our Stock—All Are 3 Phase, 60-Cycle, 3600-RPM

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6250—KVA. G.E. Sur. Cond., 200, 2300#-v.
3750—KVA. G.E. Sur. Cond., 200#, 2300-v.
3125—KVA. G.E. Sur. Cond., 200#, 2300-v.
2500—KVA. G.E. Sur. Cond., 200#, 2300-v.
1875—KVA. G.E., COND. 200#.
1565—KVA. G.E. Sur. Cond. 150#, 2300.
1000—KW. West. D.C.
1250—KVA. West. Sur. Cond. 200#, 2300.
937—KVA. Allis-C. Cond. 200#.
625—KVA. G.E. Cond. 200#, 2300-v.
375—KVA. G.E. 250-KVA. Non-Cond.

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1—275 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1175 RPM slip ring motor
1—250 HP General Electric, 3-60-440V, 450 RPM, type 1-M slip ring
1—200 HP Westinghouse, 3-60-2200V, 600 RPM syn. #4956114, direct conn. exciter and starter
2—100 HP General Electric, type I, form K, 3-60-220V 575 RPM
2—100 HP, General Electric, type 1-17, from K, 3-60-440V, 350 RPM
1—100 HP Westinghouse, type CCL, 3 ph. 60 cy., 2200 V. 1750, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph. 60 cy., 220V, 580 RPM slip ring.
1—100 HP General Electric 3 ph. 60 cy. 4000V. 720 RPM syn., type TS with direct connected exciter
1—150 HP Allis-Chalmers 3-60-440V. 450 RPM slip ring
3—100 HP, General Electric, 3-60-440V, 450 RPM sq. cage
4—75 HP G. E. 3-60-2300V, 400 RPM, type I, sq. cage
1—75 HP General Electric, type KT, frame 562, 3-60-440V, 450 RPM
1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type 1Q, 3 ph. 60 cy. 3 phase, 440V, 600 RPM Squirrel Cage
2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors
1—60 HP Lincoln 3-60-220V frame IXM, 900 RPM slip ring
1—50 KW factory built m-g set, 125 Volt Ideal 900 RPM driven by 75 HP, sq. cage 220/440 V. motor
1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K
1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring
1—60 HP General Electric, 3 phase, 60 cycle, 440 volt, 600 RPM, type MT 556 slip ring motor
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage
2—50 HP Allis-Chalmers, 3-60-440V, 720 RPM, slip ring
1—50 HP General Electric, 3-60-440V, 690 RPM, MT 546, slip ring
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage
1—50HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP General Electric type I-M, 3 ph. 60 cy. 440V, 720 RPM slip ring
1—45 KVA Fairbanks-Morse, 3 ph. 60 cy. 220 V, 1200 RPM alternator
2—30 HP Fairbanks-Morse, 3 ph. 60 cy. 2220V, 3600 RPM, type HO, frame 12B ball bearing
1—50 KW, Allis-Chalmers, factory-built, 3 bearing M-G set, 125 volt DC driven by 75 HP, 3 phase, 60 cycle, 220 volt 1165 RPM motor
2—175 HP, 230V, DC Westinghouse, type SK, 150 to 550 RPM
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400 KW. 3 unit 250/500 volt Gen. Elec. Syn. M. G. set

120 KW. 500 v. DC gasoline engine gen. set

100 KW. 125 volt, G.E., 1200 rpm. M.G. set

70 KW. M.G. Set 70 v. 1000 Amp. Burke, syn. drive

35 KW. 125 v. M. G. set.

50—New 3 HP. G.E. 1800 rpm. 220 volt slip ring motors

100 KW. 125/250 volt, 1200 rpm. General Electric synchronous rotary converter

300 KW. 250 v. West. 900 rpm. syn. rotary converter

4—200 HP. G.E. type KF vertical 440-60-3-900 Class 1-D explosion proof motors

1—100 HP. same description as above

129—15 KW. Westinghouse type SK 93, 125 volt, 1200 rpm. New D. C. single bearing Generators

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7—500 HP Heine, 210# pressure.
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2—15,625 KVA General Electric Condensing Turbines.
1—3750 KVA General Electric Condensing Turbine.
1—3000 KVA General Electric Condensing Turbine.

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3—300 KVA Fairbanks-Morse Full Diesel Engines.
3—200 KVA Fairbanks-Morse Full Diesel Engines.
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1—700 KVA Ames Uniflow Engine Generator.
1—150 KW Skinner Uniflow Engine Generator Set A.C.
1—1060—KVA Nordberg Uniflow Engine Generator.
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1—300 KW Westinghouse 3/60/220-440 or 2300 volt-3600 RPM, non-condensing turbo generator.
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TANKS—1—160,000 Gals. 1 Car Type Tank 7' x 27', 1 Gasoline Truck Tank 5,000 Gals.

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Diesel power unit about 100 HP for sawmill. Also 24" buzz planer. Write full particulars and price.

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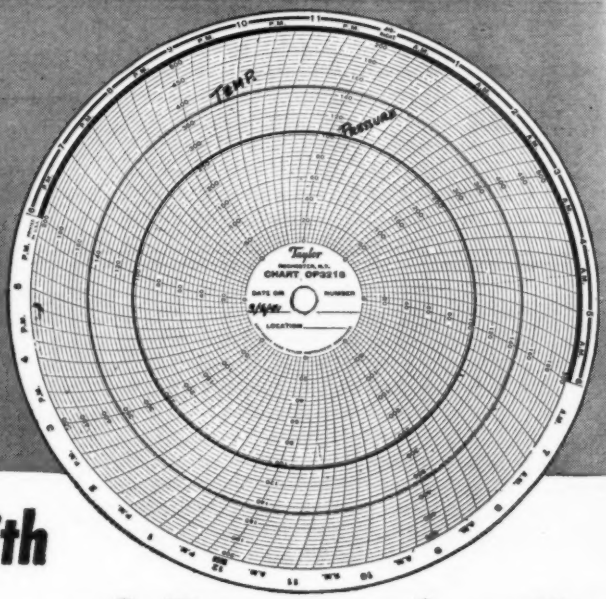

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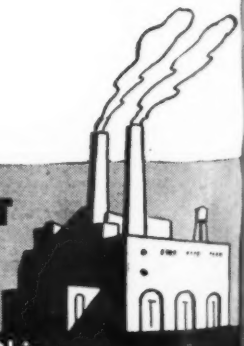

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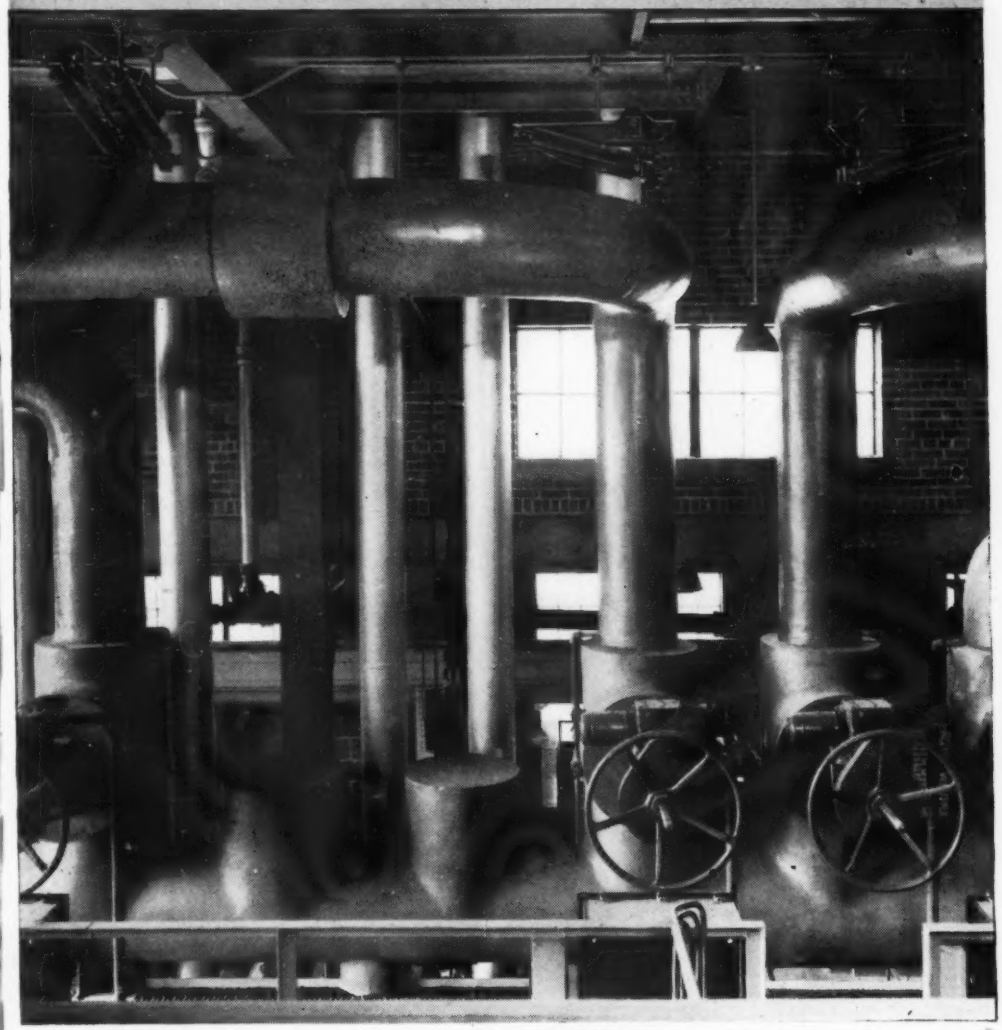

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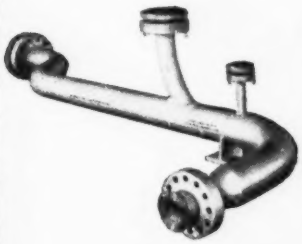

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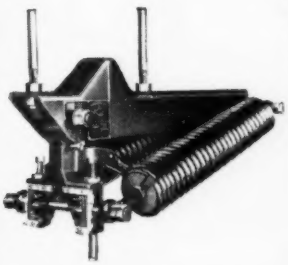

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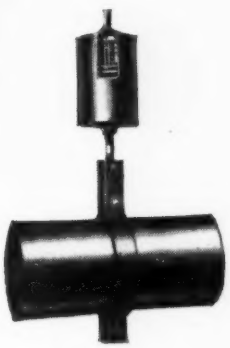

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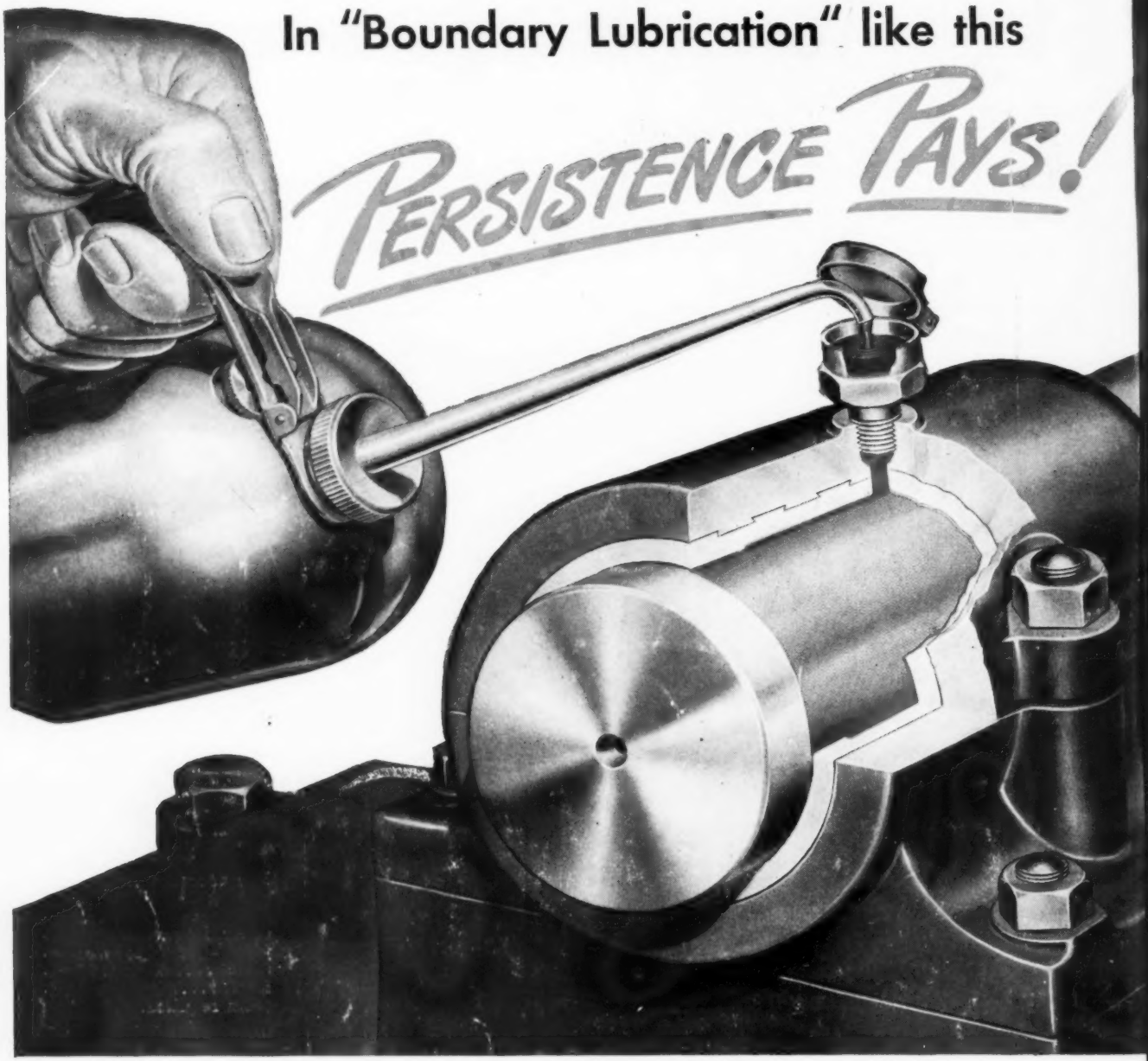

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